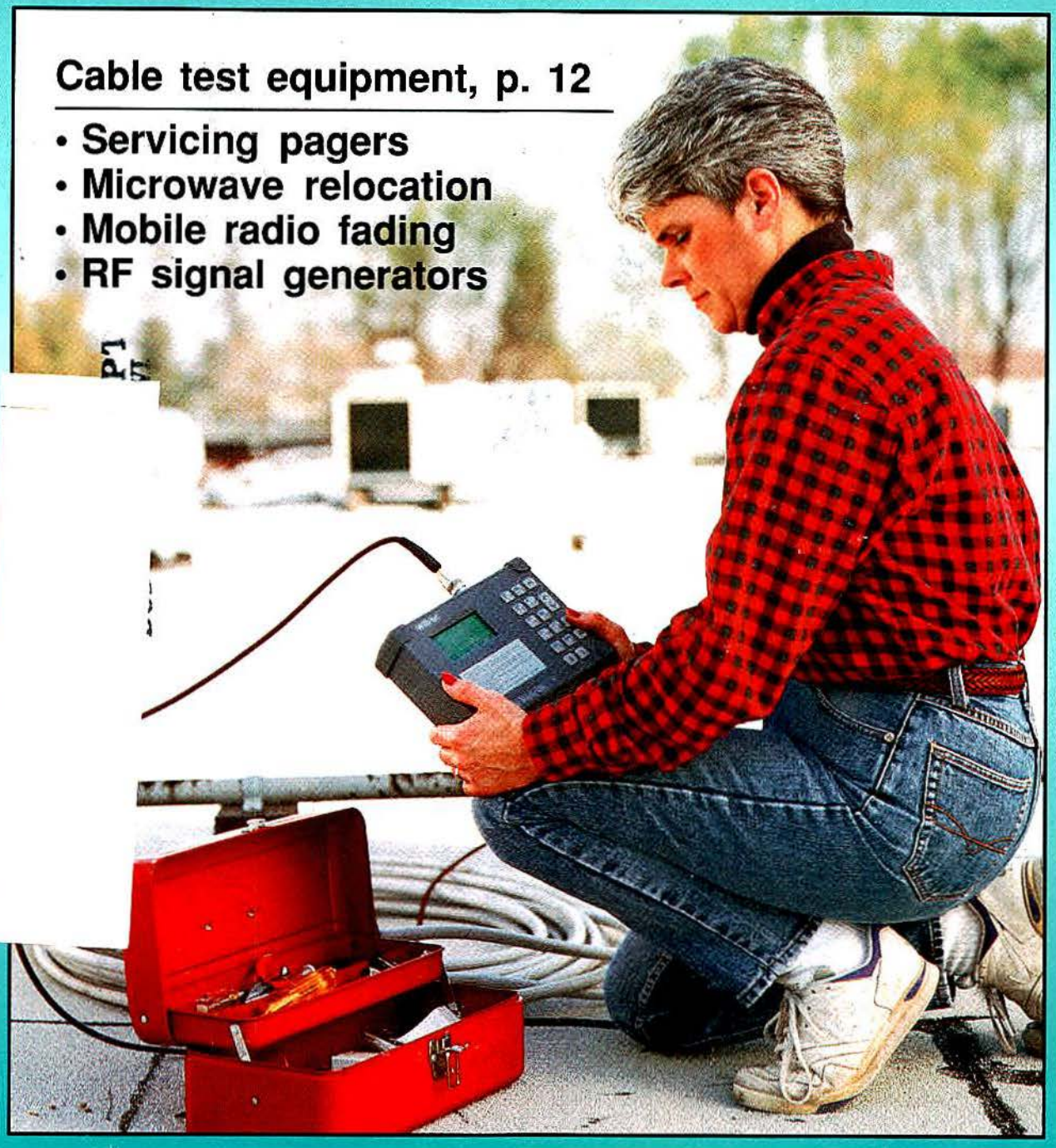
November 1995

Mobile Radio Technology™

The journal of mobile communications technology



Cable test equipment, p. 12

- Servicing pagers
- Microwave relocation
- Mobile radio fading
- RF signal generators

An INTERTEC® Publication

Your Fleet Will Retire Before Our Land Mobile Antennas.



As the industry's undisputed durability leaders, land mobile antennas from Antenna Specialists never lie down on the job. Their superior technology, materials and manufacturing keep them working year after year. So you can retire your worries about land mobile antenna failure.

Antenna Specialists designs antennas for virtually all land mobile applications. And we work overtime packing in features other manufacturers leave out. Features like rubber O-ring seals for moisture protection. 100% factory-tuned and locked coils for long-term frequency stability. And stainless steel whips for topmost durability. You can even ask for a flexible shock-absorbent spring for high-vibration environments. And all Antenna Specialists antennas are designed for peak efficiency. So they work every shift at maximum performance.



Call Antenna Specialists at 1-800-664-5274 and place your order for the highest quality antennas manufactured today. Unlike your retired fleet, the only thing our land mobile antennas will pile up is air time.

ALLEN TELECOM GROUP
antenna specialists
DIVISION

30500 Bruce Industrial Parkway
Cleveland, Ohio 44139-3996
216-349-8400
FAX 216-349-8407

Your Wireless Connection.™

Circle (1) on Fast Fact Card

The 10-site radio controller



Vega's C-5111 10-line/4-frequency console

Vega's Model C-5111 compact, easily rack-mounted, ten-line/four-frequency radio control console provides instant PTT, timed mute, and other most-needed features. This tone-format console allows you to quickly select one or any combination of up to 10 remote base stations. A second speaker allows you to monitor (with individual volume controls) any combination of those 10 stations that are not already selected for TX/RX control. Instant PTT switches allow immediate response to a call on a particular "selected" or "unselected" line, without disturbing the programming of the "selected" simulcast group or line.

Standard features available on the cost-effective and versatile C-5111 console include:

- **SELECTED switches** for selecting any combination of lines for transmitting and receiving
- **UNSELECTED switches** for monitoring any combination of unselected lines
- **TX ALL (simulcast) switch** for selecting all lines for both transmit and receive
- **RX ALL switch** for monitoring all unselected lines
- **Separate speakers and volume controls** for "selected" (TX/RX) and "unselected" (RX-only) audio
- **GROUP SELECT switch** for easy selection of TX/RX line combinations
- **TIMED MUTE switch** to mute "unselected" audio temporarily
- **Separate volume controls** for each "unselected" line
- **Instant-PTT switches** for each line
- **Line-activity LEDs** (function on all lines, selected or not)
- **Heavy-duty 120/240-V_{ac} power supply** (also runs on 12 V_{dc})

Options

- DCA-3 external three-line adapter for DC-format lines
- Gooseneck and desk microphones, headsets, footswitch
- DTMF pad
- Cross mute
- Clock, audio-level bargraph, and cross-mute indicators
- Rack-mount kit

The C-5111 has the flexibility to accommodate most any multiline console requirement. Call **1-800-877-1771** (toll-free) now for full details on the C-5111 console.

VEGA

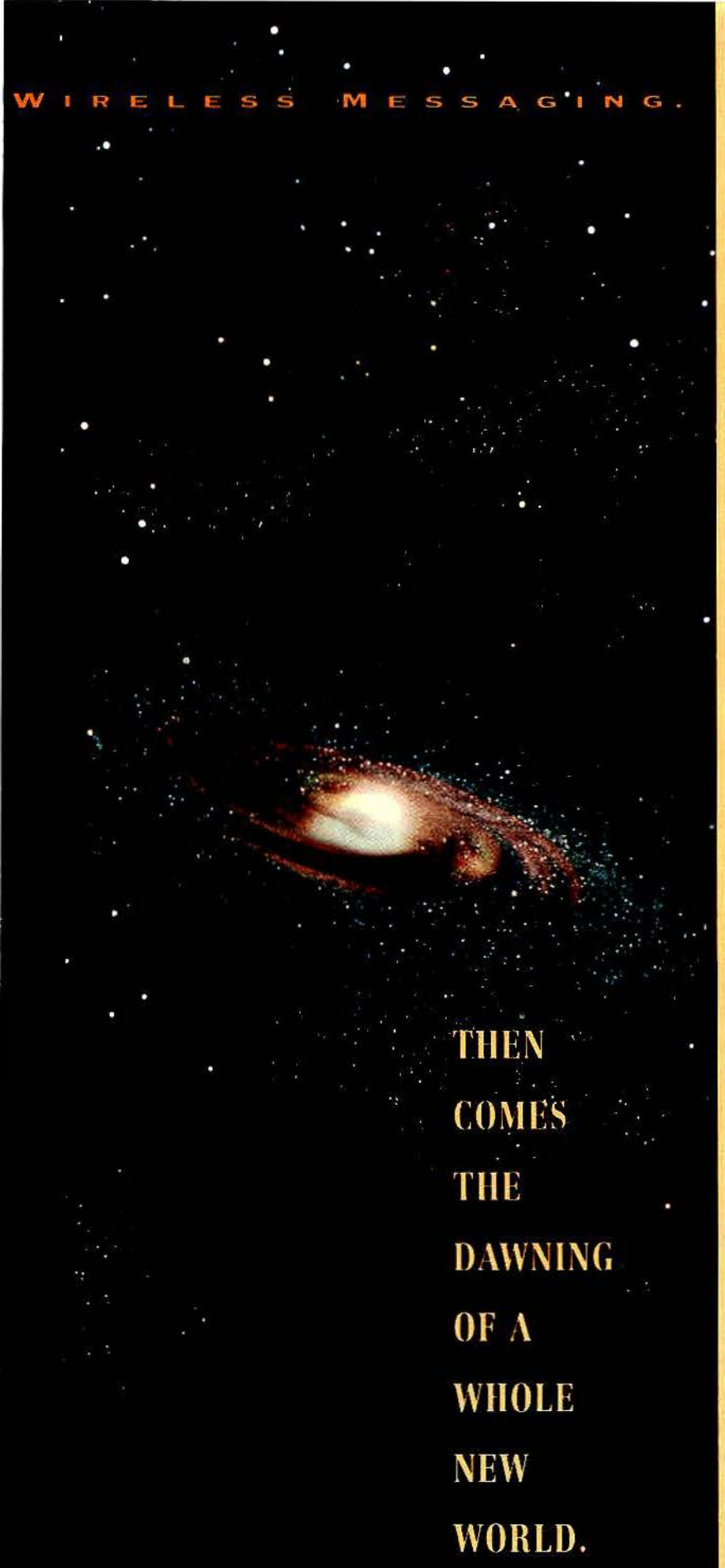
a **MARK IV** company

Signaling Products Group

9900 East Baldwin Place
El Monte, California 91731-2294
Telephone: (818) 442-0782
Toll-Free Telephone: 800-877-1771
Fax: (818) 444-1342
FaxBack: (818) 444-2017
Toll-Free FaxBack: 800-274-2017

Circle (4) on Fast Fact Card

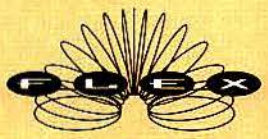

FLEX™. THE UNIVERSAL LANGUAGE OF
WHEN A BRILLIANT SOLUTION IS CREATED ...
IT WHIRLS AROUND AND TAKES FORM ...
FLEX™. The emerging
standard in
wireless messaging.
MOTOROLA
Paging Products Group



FLEX™

The wireless messaging solution of the future is now fully formed and in place, offering a whole new world of business opportunity for wireless communication providers. Motorola developed the FLEX messaging protocol to move the paging industry into the 21st century. With FLEX, you can expand your current systems now... and move your businesses into the future of advanced wireless messaging. No other protocol comes close to offering the high capacity, graceful growth, improved page delivery, efficient mixing of services–even improved battery life. And, together with ReFLEX™ two-way messaging and InFLEXion™ voice and data messaging, the FLEX family of wireless technology solutions is the cornerstone of Motorola's strategy for the future of wireless communications. FLEX is rapidly becoming the de facto standard for messaging protocols, as indicated by its worldwide adoption and penetration. And because of this, FLEX promises carriers and end users innovation, a wide variety of FLEX products and global opportunities. The future belongs to the FLEXible–wherever there's wireless messaging on planet Earth.

© 1995 Motorola, Inc.
®, Motorola, FLEX, ReFLEX and InFLEXion are trademarks or registered trademarks of Motorola, Inc.



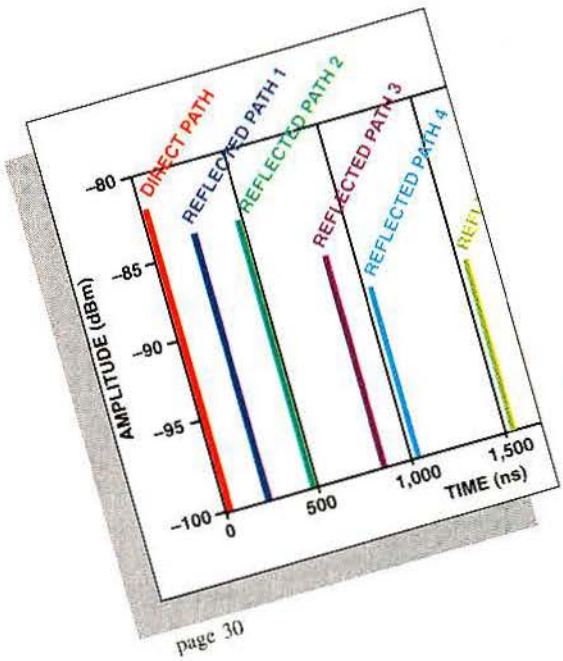
Circle (5) on Fast Fact Card

Contents

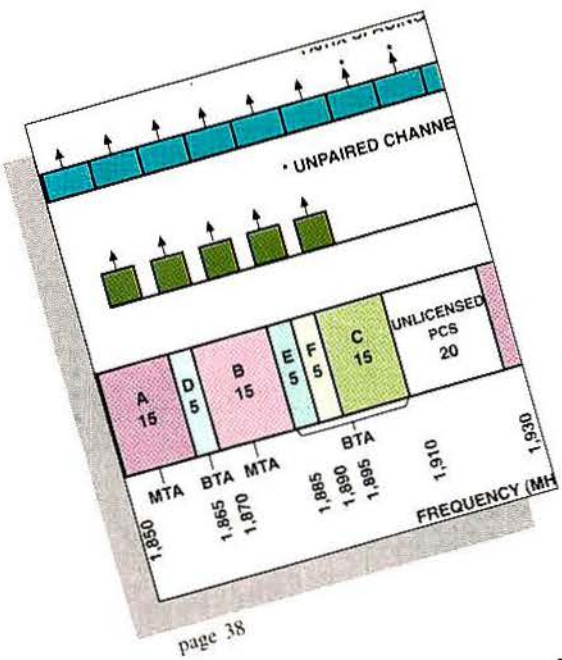
Mobile Radio Technology™

Volume 13, Issue 11

The journal of mobile communications technology



page 30



page 38

features

12 Simple measurements track wireless installation faults
Frank Ghassemi
Reflected energy in a transmission line can be used to isolate faults in antenna installations. A combination synthesized signal source, a VSWR bridge and a narrowband receiver pinpoints cable damage or discontinuities.

16 Servicing pagers: Logic/decoder boards for Bravo Plus, Bravo Express
David Ludvigson
Part 18—Circuit descriptions unlock some of the mysteries about Bravo Plus and Bravo Express pagers. Miniaturization may defeat some repair attempts, but other faults can be remedied in a well-equipped service shop.

30 How mobile radio fading affects data transmission
Barry L. Dorr
An intuitive understanding of RF fading is possible without using complex mathematics and statistics.

38 Microwave relocation: Key to early PCS deployment
Donald S. Williams, P.E.
Understanding the relocation rules and establishing a negotiating strategy will lead to early deployment of personal communication services.

On the cover: A technician uses the Site Master analyzer to check a cable installation for discontinuities. *Photo courtesy of Wiltron Company, Morgan Hill, CA.*

departments

6 Editorial

8 Calendar

10 Technically speaking
Harold Kinley, C.E.T.
Using your RF signal generator.

56 Regulating technology
Robert H. Schwaninger Jr.
There oughta be a law.

59 News
PCIA approves new industry standard protocol.

60 Product/Logo directory
Advertisers in this issue describe the products they offer.

61 New products
Radio Satellite Integrators is the "Readers' Choice."

67 Literature

68 People

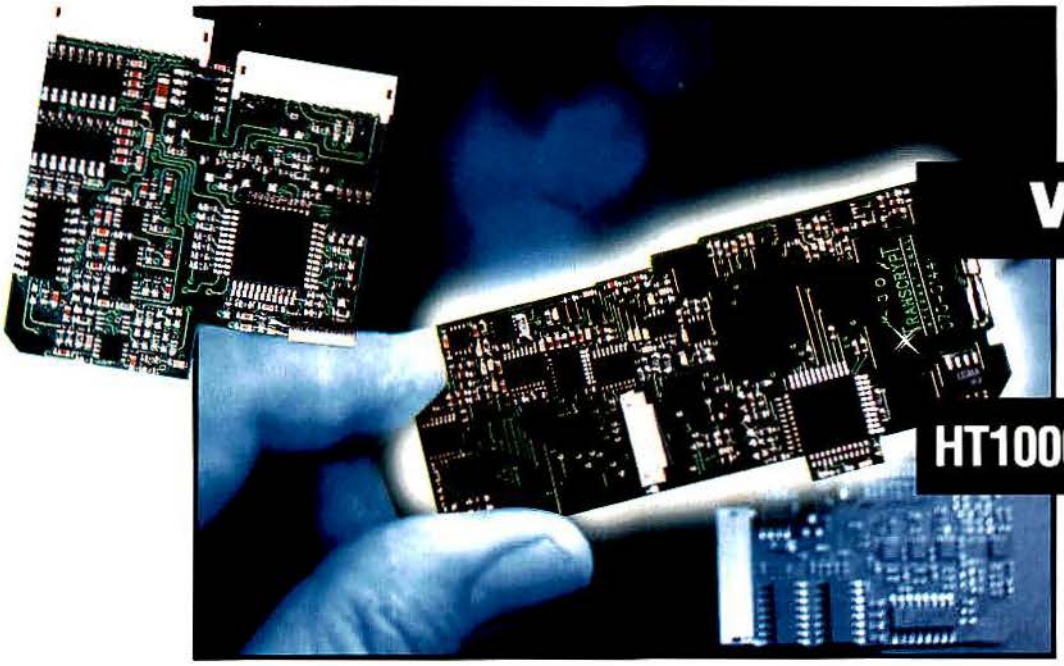
69 Letters from readers
Is this a $10 million tower?

71 Classified ads

88 Ad index/hot line
Find advertisers quickly.

Mobile Radio Technology (ISSN 0745-7626) is published monthly by Intertec Publishing Corporation, 9800 Metcalf, Overland Park, KS 66212-2215, and mailed free to qualified persons within the United States and Canada. Second-class postage paid at Shawnee Mission, KS, and additional mailing offices. POSTMASTER: Send address change to Mobile Radio Technology, P.O. Box 12960, Overland Park, KS 66282-2960.
SUBSCRIPTIONS: Non-qualified persons may subscribe at the following rates: United States and Canada: one-year: $30.00. Qualified and non-qualified persons in all other countries: one-year: $40.00 (surface mail); $105.00 (air mail). Subscription information: P.O. Box 12937, Overland Park, KS, 66282-2937.

another BREAKTHROUGH from TRANSCRYPT™



FOR VISAR™ AND HT1000™ & MT2000™

VOICE PRIVACY MADE SIMPLE

Transcrypt™ has been providing complete voice privacy solutions for more than 16 years to over 10,000 public safety, government, and industry users in 88 countries around the world. Call us to talk about adding protection to your Land Mobile Radio (LMR) or cellular communications. We're ready to listen... Privately.

- Superior Voice Quality
- Patented Continuous Sync. Process
- Compatible With Over 1500 Types Of Radios
- Affordable
- Security Levels To Fit Your Requirements
- Compact Size
- Low Power Consumption
- Over-The Air Reprogramming (OTAR)
- Works Through Existing Systems



1-800-644-3277

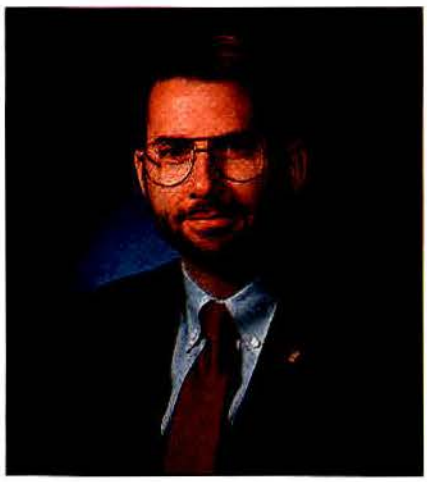
TRANSCRYPT™ INTERNATIONAL

4800 NW 1st Street, Lincoln, NE 68521 USA 402-474-4800 • FAX 402-474-4858

Circle (6) on Fast Fact Card

VISAR™, HT1000™, and MT2000™ are trademarks of Motorola Inc.

FCC: Want a bigger budget? Help small SMR operators and private system owners



A trimmer FCC may emerge next year if staff reductions announced by Chairman Reed Hundt come to pass.

Altogether, the chairman expects to cut the roster from 2,200 to 2,050. A difference of millions of dollars between the budget requested by the FCC and the budget likely to be granted by Congress are the reason. Hundt requested $223.6 million for the fiscal year beginning Oct. 1, 1995. By mid-September, the House was ready to grant $185.2 million; the Senate, $166 million.

Maybe the staff reductions will come to pass, and maybe not. The chairman wants to show what he would do without his requested budget. Today, though, who objects to cutting jobs from the federal government? Unless it's your job. Or in Hundt's case, part of the agency you run.

Many reductions will come from the commission's network of metropolitan-area field offices and rural-area monitoring stations. Will this step reduce the enforcement that controls radio interference? Maybe some, but it might not be noticeable. The field offices leave many interference complaints unresolved. There may be little reason for business and industrial radio system users to expect any less service. Losing a field office may mean just one less place to dial for a busy signal.

Priorities

Not that the FCC engineers and public affairs staff at field offices are unsympathetic to interference complaints. They already have insufficient resources to resolve them, and going from little to none won't make much difference. (The FCC's priorities for resolving interference complaints are: 1) presidential and White House communications; 2) immediate threat to safety of life and property; 3) public safety communications; 4) all others. There is little time for "all others." Commercial two-way communications are lumped into "all others" with TV and Citizens Band radio interference. [Or used to be. The FCC has announced its intention to stop enforcing CB rules altogether. Presto: no-o-o problem!])

Does the chairman have his eye on what's important? For example, is he focused on the FCC's role of assigning spectrum for the public good and controlling interference? Is he protecting the interests of entrepreneurs, such as small SMR system operators, and of private wireless system owners? No, he is focused on cash. Here's what he said on Sept. 7:

"This agency is the biggest cash cow in the history of government. To date, it has returned over $9 billion to the Treasury and the U.S. taxpayer as a result of the auctions of radio spectrum which it has conducted in record speed and to universal acclaim. This was almost 50 times the total FCC appropriation for fiscal year 1995. The Senate subcommittee would kill this cash cow, even while we're trying to milk it for billions of more dollars in auction revenue."

FCC as a sales agent

The chairman is redefining the FCC's mission as that of a spectrum real estate sales agent. The FCC, in its zeal to sell spectrum, is going beyond what Congress intended. And why would a budget reduction stop the auctions?

As it steps back from sustaining its own field enforcement, the FCC may call on the private sector for interference resolution. Complainants would telephone the FCC at a toll-free number for assistance. Callers would be referred to commercial service companies. We presume that these companies would charge the complainant a fee to investigate.

Some complainants might object to such a charge, believing that whoever is responsible for the source of the interference should pay for the investigation and resolution. Naturally, most complainants think that the responsibility lies with someone else. Sometimes, however, the interference source is traced to the complainant's own equipment.

It remains to be seen how compensation will be handled. With some complainants, the only way to be assured of payment is cash in advance! Despite the details having to be worked out, more interference complaints are likely to receive attention from a private contractor than from the FCC, with or without government staff reductions. When someone's operating practice or technical equipment has to be changed over their objections, though, the private sector would have to turn to the FCC. That much won't change. So unless the service companies can achieve compromises, a number of disputes probably will go unresolved, filed away somewhere.

Monitoring stations

And about those monitoring stations? Among other things, the monitoring stations are equipped for monitoring and investigating high-frequency (HF, or shortwave) communications. These stations have a lot of history, dating from the days of wireless telegraphy, nautical communications and overseas radiotelephone service. Their current role seems largely outdated—along with their equipment. Much of the communications traffic once supported by shortwave has moved to satellite and other links. Logic has to be stretched to fit most types of shortwave interference into one of the FCC's first three priorities.

Although the monitoring stations are listed for closing, the chairman said that technological advances will allow them to be replaced with a national automated monitoring network by the summer of 1996. (We've visited eight of the 13 monitoring stations through the years. We met some friendly, helpful people at the monitoring stations—and some pretentious, wary people, too.)

Several years ago, we saw one of the monitoring stations operated by remote control from the FCC's central facility—a new undertaking, at the time. It isn't certain what form the national automated network will take, but perhaps it includes remote operation of several of the current monitoring stations. Wherever the automated facilities are located, on the grounds of the current monitoring stations or elsewhere, they will have to have a certain amount of staff support for maintenance and security.

It doesn't take as much staff to administer spectrum auctions as it does to regulate licensing for private networks and control interference. It may be hard to justify larger FCC budgets based on spectrum sales results. Our suggestion to the chairman is to find ways to help small SMR businesses and private wireless network owners. Maybe that would justify a larger budget for regulating spectrum.

—Don Bishop

We're shipping the new Motorola R-2670 with secure test capability.

Big news! The new R-2670 Communications System Analyzer with SECURENET™ is now available for shipping! Bigger news yet: The R-2670 replaces our R-2000 series units and is the *only* test platform available that supports Motorola DES, DES-XL, DVP, DVP-XL and DVI-XL encryption algorithms!

Designed with encode and decode testing capability, the R-2670 also provides total testing parameters for Motorola SECURENET™ radios, including MTS2000™, SABER™, EXPO™, SYNTOR™, SPECTRA™ – *and* it can accept customer or test keys for encryption. In addition, the R-2670 can perform Bit Error Rate (BER) testing.

To arrange a demo or for additional information on the Motorola R-2670 with SECURENET™, call Communication Test Equipment today. Priced from $18,900 U.S. (list).

Order now.



800-505-TEST
FAX: 818-365-5742, Dept. 439

THE TEST you can TRUST™

MOTOROLA

Circle (7) on Fast Fact Card

Calendar

November

7-9—WirelessWorld Conference and Exposition, sponsored by *Cellular Business* and *Mobile Radio Technology* magazines, Moscone Convention Center, San Francisco. Contact: Chris Lotesto, 800-458-0479.

9-12—Communications Marketing Conference, sponsored by the Communications Marketing Association, Albuquerque, NM. Contact: Bernie Brownson, 303-371-8182.

17—Radio Club of America, Communications Symposium, 86th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Ron Formella, 201-652-6811.

1996

January

17-19—Mobile Communications Conference, sponsored by Frost & Sullivan, Westin Galleria Hotel, Dallas. Contact: Amy Arnell, 415-961-9000.

March

17-20—Energy Telecommunications and Electrical Association, Dallas Convention Center, Dallas. Contact: 214-235-0655.

25-27—Wireless, sponsored by the Cellular Telecommunications Industry Association, Dallas. Contact: 202-785-0081.

April

24-26—International Wireless Communications Expo, Las Vegas Convention Center, Las Vegas. Contact: 800-828-0420.

May

29-31—Canadian Wireless—Wireless Communications Between People, sponsored by the Canadian Wireless Telecommunications Association, Metro Toronto Convention Center, Toronto. Contact: 613-233-4888.

June

16-20—UTC national conference & Exhibition, sponsored by UTC, The Telecommunications Association, Marriott Hotel and Bartle Hall Convention Center, Kansas City, MO. Contact: 202-872-0030.

24-27—Supercomm, sponsored by USTA and TIA, Dallas Convention Center, Dallas. Contact: 202-326-7300.

July

11-13—Communications Expo/Show of the Americas, Miami, FL. Contact: 305-229-9992.

August

11-15—Association of Public-Safety Communications Officials—International National Conference, San Antonio, TX. Contact: 800-949-2726.

September

19-21—Personal Communications Showcase, sponsored by the Personal Communications Industry Association, Moscone Convention Center, San Francisco. Contact: 800-326-8638.

October

30-Nov. 1—WirelessWorld Conference and Exposition, sponsored by *Cellular Business* and *Mobile Radio Technology* magazines, Orange County Convention/Civic Center, Orlando, FL. Contact: Susan Link, 913-967-1969.

November

15—Radio Club of America, Communications Symposium, 87th Anniversary Dinner and Awards Presentation, New York Athletic Club, New York. Contact: Ron Formella, 201-652-6811.

Mobile Radio Technology™

The journal of mobile communications technology

EDITORIAL
Don Bishop, *Editorial Director*
David Keckler, *Senior Associate Editor*
Ellen Payne, *Associate Editor*
Harold Kinley, C.E.T., *Contributing Editor*
David Ludvigson, *Contributing Editor*
Roald Steen, *Contributing Editor*

INDUSTRY CONSULTANT
Fred M. Link

REGULATORY CONSULTANT
Robert H. Schwaninger Jr.; *Brown and Schwaninger, Washington, DC*

EDITORIAL ADVISORY BOARD
Gene A. Buzzi, *President, Omnicom Telecommunications Engineering, Tallahassee, FL*
Jack Daniel, *The Jack Daniel Company, Cucamonga, CA*
Gary David Gray, P.E., *Chief Telecommunications Engineer, Orange County Communications, Orange, CA*
Frederick G. Griffin, P.E., *President, Frederick G. Griffin P.C., Lynchburg, VA*
Mary Kjorvestad, *Empire Mobile Communications, Houston*
Larry Kline, *Beachwood, OH*
S.R. McConoughey, P.E., *Mobile Communications Consulting, Gaithersburg, MD*
Art McDole, *Salinas, CA*
Herb Sachs, *Herb Sachs Consulting, Bowie, MD*
Robert C. Shapiro, P.E., *President, Strategic Telecommunications, Dallas*
Leon Spencer, *Exxon Computing Services Company, Houston*
Dr. Gregory M. Stone, *Senior Associate; Booz, Allen & Hamilton, McLean, VA*
Raymond C. Trott, P.E., *President, Trott Communications Group, Irving, TX*
William A. Wickline, P.E., *Mentor, OH*

CORRESPONDENCE: Editorial and advertising correspondence should be addressed to P.O. Box 12901, Overland Park, KS 66282-2901, 913-341-1300, fax: 913-967-1904.

MOBILE RADIO TECHNOLOGY provides technical information to dealers, community repeater operators, specialized mobile radio operators, conventional and cellular RCC and WCC, mobile radio equipment manufacturers, manufacturers' reps, distributors, engineering/consulting firms, national/state/local government, military agencies, public safety agencies, transportation companies, petroleum/energy products companies, public utilities and others allied to the field.

PHOTOCOPY RIGHTS: Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by Intertec Publishing, provided that the base fee of US $2.00 per copy, plus US $00.00 per page is paid directly to Copyright Clearance Center, 222 Rosewood Dr., Danvers, MA 01923, USA. The fee code for users of the Transaction Reporting Service is 0745-7626/1995 $2.00 + $00.00. For those organizations that have been granted a photocopying license by CCC, a separate system of payment has been arranged. Prior to photocopying items for educational use, please contact CCC at 508-750-8400. Organizations or individuals with large quantity photocopy or reprint requirements should contact Chris Lotesto, 312-435-2359.

BACK ISSUES: Copies of most issues printed within the past two years are available; older issues are not. Call customer service at 800-441-0294.

ARTICLE PHOTOCOPIES: Photocopies of individual articles printed since January 1983 may be ordered from UMI Information Store at 800-248-0360.

MICROFILM COPIES: Copies of issues by calendar year are available on microfilm for 1992, 1993 and 1994. Older issues are scheduled for microfilming later. Write UMI at P.O. Box 1346, Ann Arbor, MI 48106-1346, or call 313-761-4700 or 800-521-0600, Serials customer service, ext. 2895.

BPA ABP

Audited circulation. $3.00 + 0.00

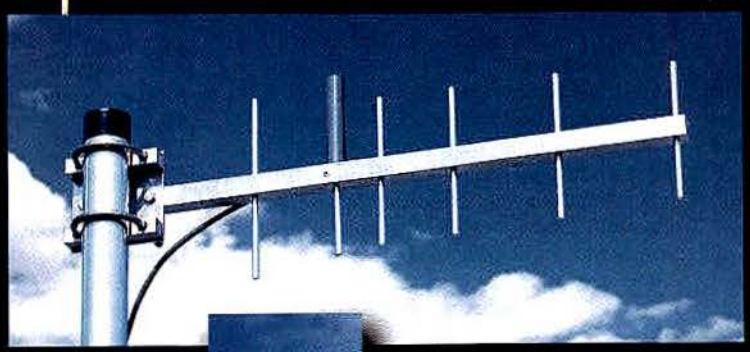
INTERTEC PUBLISHING

© 1995 by Intertec Publishing. All rights reserved.

Performance Antennas

For Voice and Data Communications

Cushcraft/Signals has been building antennas for over 40 years. We offer a full line of base and mobile antennas that span a frequency range of 25 MHz to 2.5 GHz and a price range just as versatile. We are continually improving and expanding our product line to meet the demands of this dynamic market. Whatever your needs, chances are we can help.



Welded Yagis

Performance, long-life and economy were the design goals for the PC Yagi series. All welded construction means quiet, trouble-free operation.

- All-welded joints
- Sealed feedpoint
- Pigtail feed
- 6, 9, 11 & 13 dBd models



Fiberglass and Polycarbonate Omnis

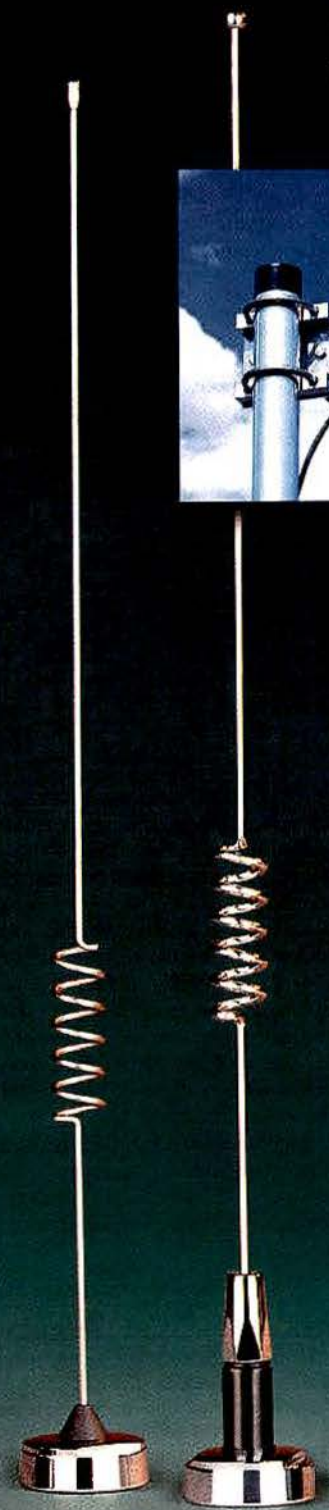
Available for 800 & 900 MHz, 1.4, 1.8 & 2.4 GHz

Omnidirectional antennas are available for all of the high frequency services from trunking and cellular through PCS and 2.4 GHz spread-spectrum applications.

- All-weather performance
- Choice of connectors • Cost effective pricing

Mobile Antennas

Cushcraft/Signals offers a complete line of mobile antennas for all applications from low band through PCS. Standard designs are available for delivery today from your favorite distributor.



ULTRALINK®
CABLE

Base and mobile UltraLink were designed specifically for communication applications. Low loss, ease of use, low cost and immediate availability are synonymous with UltraLink. See our catalog or call for details.



Cushcraft/Signals supplies a complete line of base and mobile antennas. Call us or your favorite distributor for fast delivery or our latest catalog.

1-800-258-3860
FAX:1-800-258-3868

cushcraft/Signals

Circle (8) on Fast Fact Card

48 Perimeter Road, Manchester, NH 03103 USA • Telephone: 603-627-7877 • FAX: 603-624-1764

Using your RF signal generator

By Harold Kinley, C.E.T.

The RF signal generator is an indispensable piece of test equipment. Its usefulness is not limited to performing standard specification tests—it is also quite useful in running many troubleshooting procedures. Let's take a look at some of the ways in which the RF signal generator is used in the radio shop.

Sensitivity tests

Probably the most frequent use of the RF signal generator is running the 12dB SINAD sensitivity test. Figure 1 below shows the SINAD sensitivity test setup. As was mentioned last month, it is most important for the RF signal generator's output level, modulation level and the modulating frequency to be highly accurate when running the standard test procedures. A deviation level of ±3kHz is used to check receiver sensitivity. The generator output level is adjusted to produce 12dB SINAD. The generator output level at this point is taken as the 12dB SINAD sensitivity of the receiver under test.

If you are using a signal generator with an internal audio generator and you use the internal audio generator to produce a 1kHz tone to modulate the signal generator output, make sure that the 1kHz tone falls deep within the SINAD meter's notch. If the 1kHz tone falls outside the notch, then your measurements will be invalid. To test this notion, feed the 1kHz modulating tone directly into the SINAD meter. The meter or display should indicate a high SINAD reading (low on the meter scale). If the SINAD reading is only −12dB or −14dB SINAD, then the tone frequency should be adjusted or the SINAD meter should be adjusted for *maximum null*. Even if the modulating tone is not exactly 1kHz, the important point is that the modulating tone should fall deep within the notch of the SINAD meter.

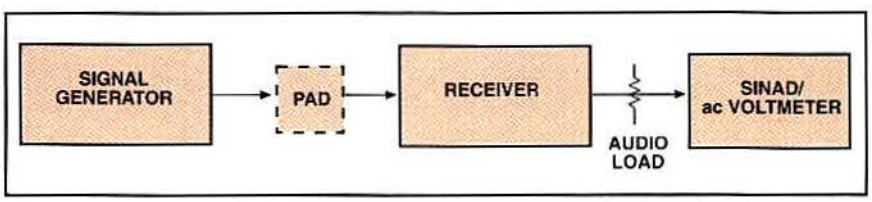


Figure 1. This setup is used in many of the test and measurement procedures described in the text. Padding always improves the impedance matching between the signal generator and the load, thus enhancing the test setup.

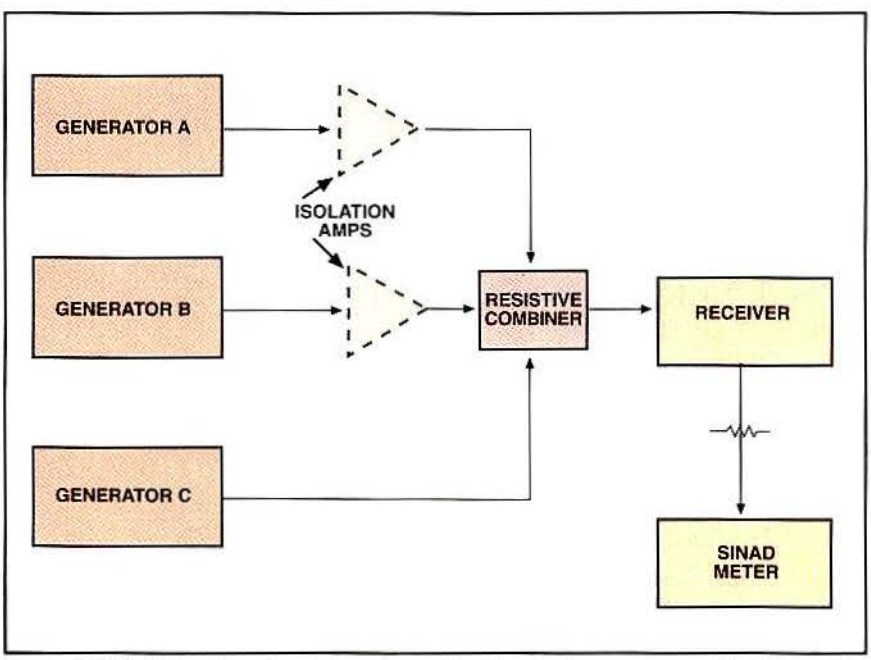


Figure 2. This test setup shows how three signal generators are connected to run the intermodulation rejection test on a receiver. The isolation amplifiers improve the isolation between the signal generators, making sure that the intermod signal is not formed outside the receiver.

Modulation acceptance bandwidth

The modulation acceptance bandwidth test usually is performed immediately after the SINAD sensitivity test. The same setup shown in Figure 1 is used. Once the SINAD sensitivity test is run, the signal generator level is increased by 6dB (double the microvolts) and then the deviation level is gradually increased until the SINAD reading returns to 12dB SINAD. The signal generator deviation level at this point is the receiver's *modulation acceptance bandwidth.*

Residual noise

A receiver's residual noise level is a measure of how much noise is generated within the receiver when a high-level, unmodulated carrier is applied to the receiver RF input. Typically, the reference level is established as the voltage level at full audio output power using a 1kHz modulating tone at ±3kHz deviation on the signal generator.

Let's say that the receiver audio output power fed to an audio dummy load is 5W. If the output load is 2Ω, then the reference voltage level is determined from the following formula:

$$E = \sqrt{PR} = \sqrt{10} = 3.16V$$

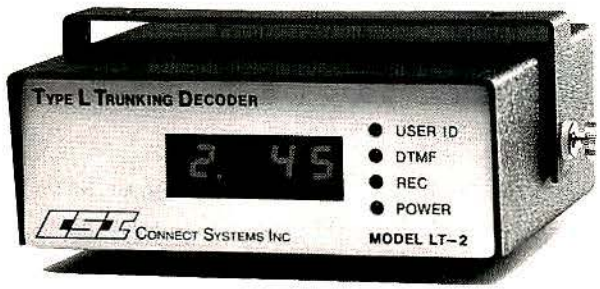
Once the reference level is established, the signal generator modulation is turned off, leaving only the carrier. It is important that the signal generator not contribute any noise modulation. If the generator is injecting noise into the receiver, then the true residual noise level of the receiver can be masked by the generator noise, and the measurement will be invalid. Some synthesized signal generators included as part of service monitors are notoriously noisy, and the noise renders them useless for this kind of receiver test.

If the signal generator is quiet, the measured noise level from the receiver output should be around 45dB to 50dB down from the reference level. An ac voltmeter with a

(continued on page 52)

Kinley, a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual: With Instrumentation and Testing Techniques*, Prentice-Hall, 1985. He is a member of the Radio Club of America.

IF YOU OPERATE AN LTR® SYSTEM YOU NEED THIS DECODER



The all new **LT-2** can be connected to any service monitor or scanner and displays user ID and home repeater of all users received on any **LTR®** input or output channel. In addition, all subaudible decoded data is available on the standard RS-232 serial output port.

The optional LT-2P application program for your IBM PC compatible provides a wealth of system data which can be viewed anywhere within mobile or system range. Here's a sample...

When Monitoring an **LTR®** Output Channel:

- Stores/Displays History of System Usage
- Displays Current User ID and Home Repeater
- Displays all handoff information
- More

When Monitoring an **LTR®** Mobile Direct:

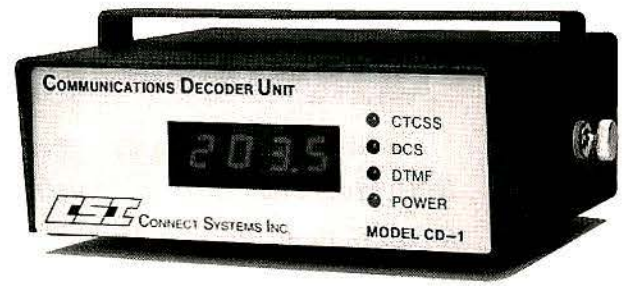
- Shows Current User ID and Home Channel
- Displays DTMF originating from mobile
- More

Statistics available when computer is connected:

- Usage Time and Date per User
- Hits per User
- More

Note: *Some information is limited to users homed on repeater being monitored.*

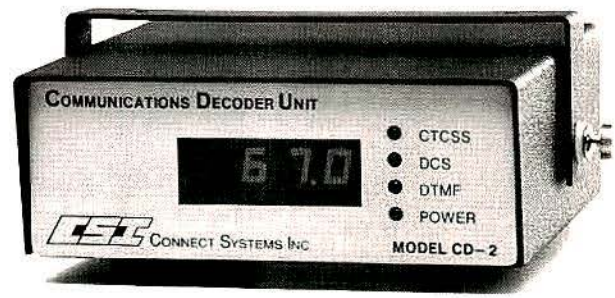
IF YOU SERVICE CONVENTIONAL RADIOS YOU NEED A CD-1



The **CD-1** Displays all CTCSS, DCS and DTMF codes on the channel you are monitoring. DTMF sequences (up to 128 digits) are stored and replayed slowly so that you can observe fast ANI codes. Only one connection required to any service monitor or scanner. Thousands in use worldwide.

- 50 CTCSS Codes
- 104 DCS Codes
- 16 DTMF Digits

THINK OF OUR NEW CD-2 AS A CD-1 WITH A SERIAL PORT ADDED



The all new **CD-2** is operationally identical to the **CD-1** with the addition of an **RS-232** serial port.

The optional **CD-2P** application program allows your IBM compatible PC to store and display the following as it occurs, on the channel you are monitoring...

- CTCSS Code
- DCS Code
- DTMF sequences
- Hits per DCS/CTCSS Code
- Airtime per DCS/CTCSS Code
- Time and Date per usage
- Download and printout all programming data from your TP-154 and TP-154 PLUS tone panels
- More

Call *Ray Dashner* at **800-545-1349**
today for the complete story!
Made in U.S.A.

In Canada: Cartel (800) 663-0070 Eastcom (800) 263-2323

CSI®
CONNECT SYSTEMS INC.
2259 Portola Rd. Ventura, Ca 93003
Phone (805) 642-7184 Fax (805) 642-7271

CSI is a registered trademark of Connect Systems Inc. LTR is a registered trademark of E. F. Johnson Company

Circle (9) on Fast Fact Card

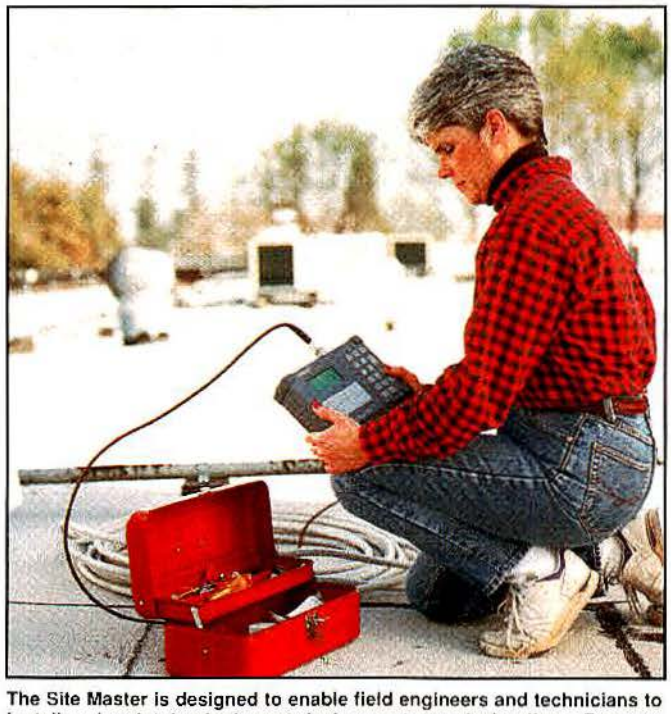
Simple measurements track wireless installation faults

Reflected energy in a transmission line can be used to isolate faults in antenna installations. A combination synthesized signal source, a VSWR bridge and a narrowband receiver pinpoints cable damage or discontinuities.

By Frank Ghassemi

Wireless systems rely on good antenna performance at cell sites, repeaters and base stations. But what happens when one of these communications installations begins to fail? How does a maintenance crew find a fault or break in a transmission line leading to the antenna? Simple reflectometry techniques and a powerful hand-held instrument can provide the answers.

Failures at cell sites can be expensive. Cellular providers are faced with a growing challenge from personal communications services (PCS) licensees that will be using digital modulation techniques such as time-division multiple-access (TDMA) and code-division multiple-access (CDMA) to pack more callers into narrow bandwidths. Cellular providers will be forced to maintain high-quality service to keep their customers.



The Site Master is designed to enable field engineers and technicians to install and maintain single port devices or transmission lines. Features include settable limit lines with both visual- and audible-pitch indication.

Cell-site commissioning and maintenance traditionally has been performed with fairly expensive and bulky test equipment, including spectrum analyzers, tracking signal generators and time-domain reflectometers. Keeping such equipment calibrated while transporting it to remote sites can challenge the most dedicated service technician.

Fortunately, test instrument manufacturers have begun to respond to the needs of testing communications equipment in remote sites by miniaturizing their equipment and by combining several measurement functions in a single instrument. An example of this is the Site Master analyzer shown in Photo 1 above and on the cover. Each analyzer combines a synthesized signal source, a voltage-standing-wave-ratio (VSWR) measurement bridge and a detector-based tuned receiver to measure the return loss (signal reflections) of communications cables and antennas at remote sites. (See Figure 1 on page 13.)

The analyzer is designed for 50Ω systems and can be adapted for 75Ω use with a 50Ω-to-75Ω transformer and 75Ω calibration components. The instrument weighs less than 2.2lbs (1kg) and measures 8" × 7" × 2.25". It includes a rechargeable battery pack that provides about three hours of operation per charge.

Units are available in single bands (model 110, which operates from 700MHz to 1,100MHz) and with three frequency bands (model 330, with bands of 700MHz to 1,100MHz, 1,400MHz to 2,200MHz, and 2,100MHz to 3,300MHz). Typical accuracy is ±1dB for return loss measurements from 0dB to 20dB, and ±2dB for return loss measurements from 20dB to 35dB.

How it works

At a cell site, antennas are connected to communications electronics equipment (transmitter, receiver, switching and signal processing) by means of coaxial cables or, in rare cases, waveguide. High-power 0.5-inch-diameter cable with a foam dielectric exhibits about 3dB of attenuation per 100 feet. The same-diameter copper cable with foam dielectric exhibits attenuation of about 2.2dB per 100 feet. Both cables have similar power-handling capabilities. For higher power-handling capability with low loss, copper cables with air dielectrics are generally used. Waveguide transmission lines offer the lowest-loss performance but are the most difficult connecting lines to install because of their inflexibility.

When a discontinuity, such as a break, a crushed cable or a

Ghassemi is product marketing manager for the Microwave Measurements Division at Wiltron Company (Anritsu Wiltron), Morgan Hill, CA. The company manufactures the Site Master series of instruments described in this article.

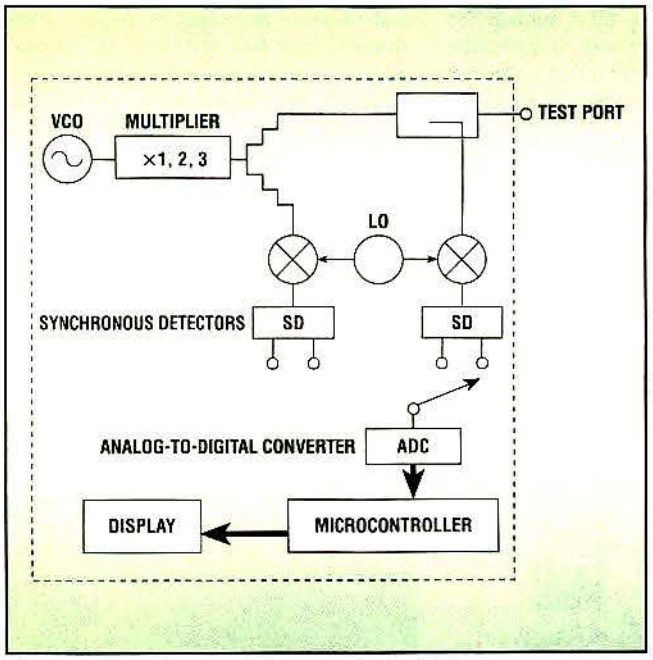


Figure 1. The analyzer combines a synthesized signal source, a return-loss bridge and a tuned receiver within a portable, battery-powered package.

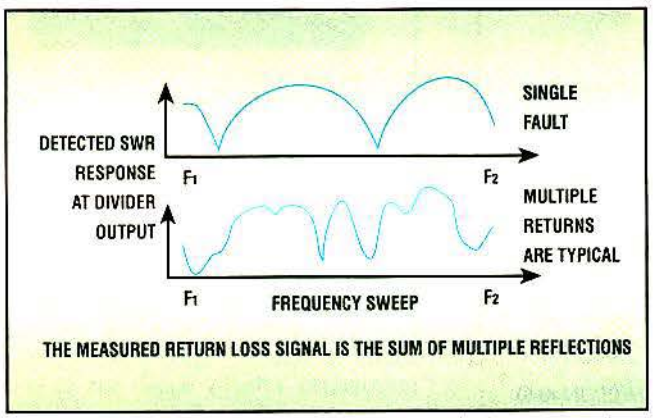


Figure 2. A single fault in a transmission line results in two return-loss ripples (top), whereas multiple faults lead to more complex ripple patterns.

bad connector splice, occurs in one of these transmission cables, power is lost and the cell site falls below specified performance limits, resulting in dropped calls or missed connections. Traditionally, a spectrum analyzer or scalar network analyzer is used to analyze the amplitude characteristics of the cable-to-antenna link.

Using a reflection bridge, which allows direct (incident) and reflected signals on a cable to be measured and compared, installers and technicians traditionally have used network analyzers with swept signal sources to make return loss or VSWR measurements on the cable-to-antenna link to detect discontinuities. Return loss, as the name implies, is simply the loss of energy through a conductor caused by reflected energy that mixes in and out of phase with forward energy.

In principle, any reflections in a transmission line will add ripples to a return-loss measurement. In a cable with a single fault, for example, two amplitude ripples will appear in a return-loss measurement plot. (See Figure 2 above.) The first ripple is caused by the incident test signal on the detector used for the measurement. The second ripple is caused by signals reflected back to the source from the fault.

When a cable has multiple faults or discontinuities, the reflected signals mix together and cause a measurement plot with numerous ripples. The reflections from multiple discontinuities sum together into a resultant waveform in the frequency domain (where amplitude is plotted as a function of frequency) that can be used to track down faults in the time domain (where amplitude is plotted as a function of time or distance from a starting point, such as the signal source).

Even in the frequency domain, the amplitude of these return-loss ripples usually provides information about the nature of a discontinuity. (See Figure 3 below right.) Smaller ripples may occur because of impedance mismatches in a cable, perhaps caused by coaxial adapters. The largest ripples are caused by a break in the line. The frequency-domain return loss data can be translated to the time domain by means of a Fast Fourier Transform (FFT). The FFT uses the periodicity of the return loss ripples and their relative magnitudes to determine the location of the individual faults.

Immunity to interference

Live site testing is difficult with traditional test tools. External sources of noise, for example, can interfere with broadband diode-based detection equipment. In addition, measurements with spectrum analyzers and tracking generators often can be affected by in-band transmissions that are common at mobile-radio test sites. The receiver in the analyzer is shielded against external noise sources and, by operating in relatively narrow bands (compared to a spectrum analyzer), the instrument is designed to provide a high degree of out-of-band noise rejection.

With one of these instruments, fault location begins with return-loss measurements on a cable or antenna installation. The return-loss data are stored and examined for traces of a fault. If

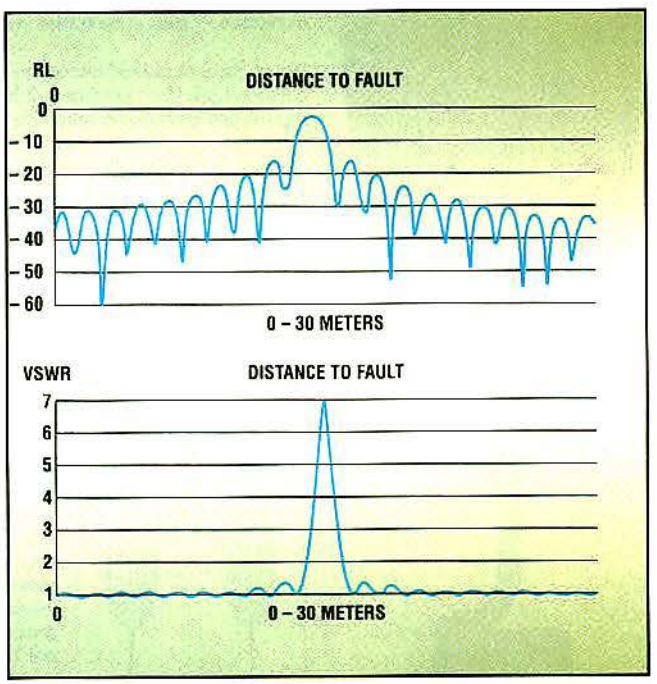


Figure 3. Using the Site Master analyzer, mobile radio site installers and technicians can use return loss (top) or VSWR (bottom) data to track the distance to a fault in a transmission cable.

the return loss is unusually high, the fault can be found by downloading the return-loss data to a personal computer and by analyzing the data with a simple fault-location software program. How to use the Windows-based software can be learned within a few minutes with minimal instruction.

The software allows return-loss data from a cable-to-antenna link to be manipulated. Such corrections validate these data when converted to the time domain for locating faults. Corrections include the inherent attenuation of the cable under test and the propagation velocity of the cable.

A return-loss vs. distance plot will change according to the attenuation characteristics of a particular cable. Cables with air dielectrics, which have inherently low loss, will yield different return-loss vs. distance characteristics under ideal conditions than higher-loss cables, which tend to show decreased amplitude levels over an equivalent distance. By "normalizing" the attenuation characteristics of different cables, the analysis software can find faults effectively even when different cables are used in the same antenna site.

A cable's propagation velocity is used to scale the distance data in the same graph. Transmitted signals travel at different speeds in different dielectric materials. A material's propagation constant is a complex quantity with a real term and an imaginary term. The real term, the attenuation constant, is a measure of the reduction in amplitude of the transmitted signal energy. The imaginary term, the phase constant, is a measure of the amount of phase shift that transmitted signals experience through a given dielectric material.

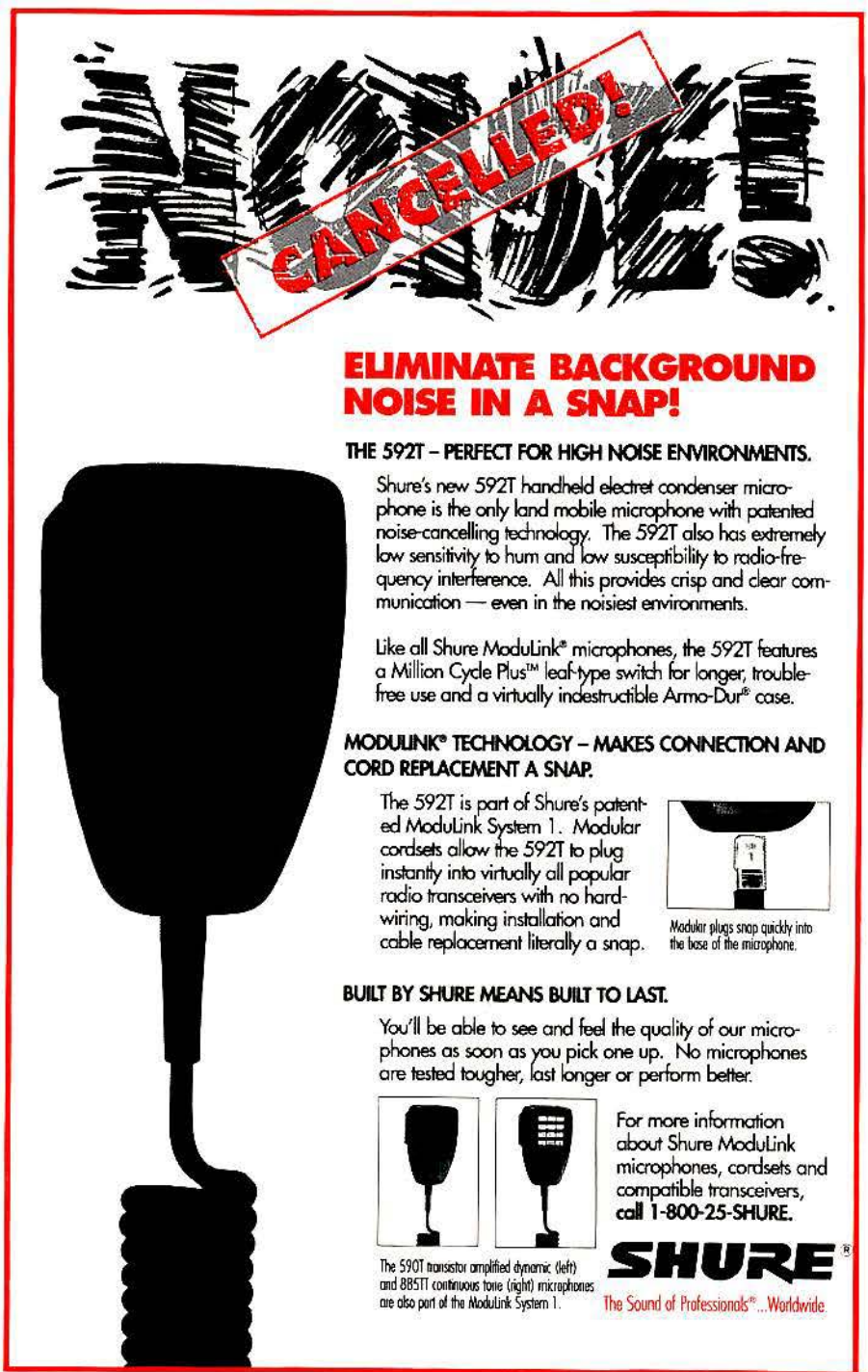


Photo 1. The Site Master analyzer is a compact instrument that provides distance-to-fault measurements on mobile-radio base station and cell-site installations.

For example, air, with a dielectric constant of 1, causes less attenuation and phase shift than materials with higher dielectric constants, such as Teflon insulation. The propagation velocity equals the inverse square root of the dielectric constant. The dielectric constants for similar types of cables can vary by as much as 10%.

The resolution of a return-loss/FFT analysis can be improved by either increasing the sweep range of the measurement or by increasing the number of frequency points used in the measurement. Any increase in the number of frequency points also will increase the time required to perform the measurement, however.

To increase the distance range of the measurement, the sweep range must be decreased. For example, with 100-foot cable, the analyzer typically can provide resolution to 1 foot with a 100MHz sweep range. This resolution is precise enough for a cable installer or a maintenance crew to find a trouble spot in a cable installation without climbing the length of a tower.



Circle (10) on Fast Fact Card



Extra! Extra! Extra sites on building tops and mountain tops.

The front page news is Meridian's continued growth in *both* building top *and* mountain top antenna sites. The follow-up story is our commitment to meeting your expanding needs—just tell us what you need and we'll respond. Our loyal readers are already familiar with our library of prominent antenna sites that stretches from the Mexican border to Santa Maria.

And when it comes to site features, we wrote the book. For example, we're installing continuous site monitoring to bring in reports on temperature, electricity status and other vital statistics.

Our state-of-the-art facilities include features like a new high-security access system, stand-by power, air conditioning, and comprehensive site maintenance. And all sites are continually being upgraded.

To locate your equipment at one of our sites, or for more information, you can always count on Jack and Rich Reichler to go the *extra* mile. For starters Meridian will send you a FREE Pocket Site Selector and Organizer when you call **(800) 400-SITE.**



FREE!
Filled with essential info and California sites

Great sites, great service, since 1956.

Meridian Communications

23501 Park Sorrento, Suite 213A, Calabasas, CA 91302-1355
(818) 222-5655 • (800) 400-SITE (7483) • Fax (818) 222-2857

Circle (11) on Fast Fact Card

SEE US AT WIRELESSWORLD EXPO, November 7-9, Booth #1102.

Servicing pagers: Logic/decoder boards for Bravo Plus, Bravo Express

Part 18—Circuit descriptions unlock some of the mysteries about Bravo Plus and Bravo Express pagers. Miniaturization may defeat some repair attempts, but other faults can be remedied in a well-equipped service shop.

By David Ludvigson

Ludvigson is a technician in Houston.

The November 1994 article "Servicing Pagers: Microprocessor Board" introduced you to the Motorola Bravo pager's logic board. With that information as a background, this article covers the Bravo Plus version of the same board. Part number references can be found in the appropriate Motorola technical manuals.

The 'wake-up call'

As the Bravo Plus is first activated, a RESET is performed at pin 78 of the microprocessor (U025). This pin is held "low" for the time it takes to charge capacitor C5, and this "master RESET" causes the entire pager to perform the following operations:

(1) The power supply and voltage doubler circuitry is enabled. This action provides the 3V power to operate the entire microprocessor and logic functions.

(2) Once the 3V supply is operating smoothly and verified by proper operation at U023, the clock oscillator should be churning out a signal at 38.4kHz (pin 71, U025).

(3) With the 38.4kHz clock signal operating and the RESET invoked, the microprocessor address counter is reset to the lowest register. Each subsequent clock cycle (coming through an appropriate divider network) moves the operating system up, one notch at a time, through a copyrighted Motorola program. Although no portion of that program is divulged here, it is possible to observe several functions and to identify "what occurs when" to help with troubleshooting this remarkable board.

As the wake-up call proceeds, information stored in the codeplug (U024) is transferred from pin 2 of U024 to pin 2 of the microprocessor (U025), where the data are stored in various registers located in U025. This information includes everything that was programmed using the software, along with some mathematically derived information. More on this in a bit (or is it "byte"?).

Once the information transfers from the codeplug, the clock moves through each succeeding register, performing each software instruction located at each register. These instructions include testing the current position of various switches, testing battery status, testing 3V level status, resetting the "wake-up" for the liquid crystal display (LCD) to display a full-segment load of 12 digits, and then settling down to a time display in the window. The characteristic "four sets of two chirps" and the flash of DS021 round out the light-and-trumpet show, and the Bravo Plus is ready to begin its day.

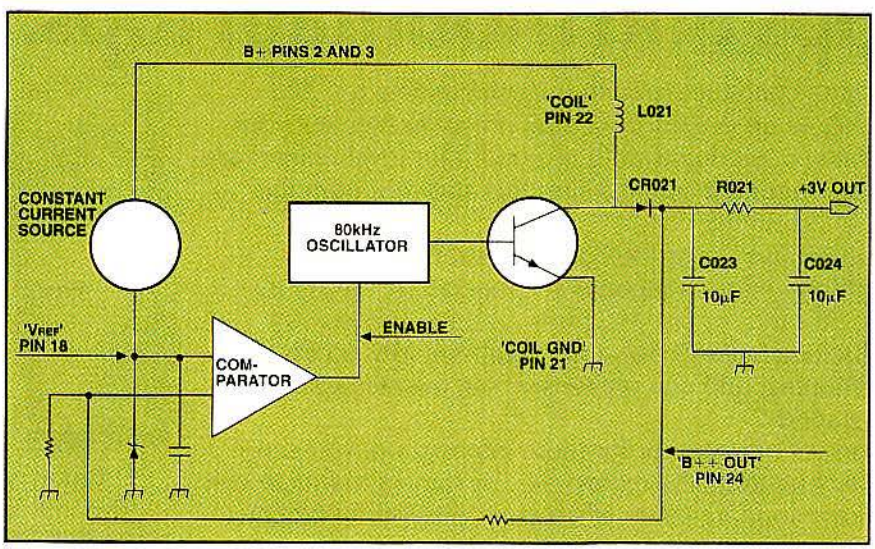


Figure 1. Few portions of the Bravo pager family are as important as the U023 3V power supply shown in this block-and-equivalent circuit diagram. This supply maintains the operating voltage for the microprocessor and logic circuitry. Without it, the pager would be nothing more than a radio receiver.

The 3V power supply

Few portions of the Bravo pager family are as important as the 3V power supply. (See Figure 1 to the left.) This supply maintains the operating voltage for the microprocessor and logic circuitry, and without it the pager would be nothing more than a radio receiver.

WHY GAMBLE WITH SPEECH SECURITY?

A ♥ **TVS-2U**



Tactical Rolling Code Voice Scrambler

- High-security scrambler with 100 million keyboard-programmable codes per system ID
- Thousands of unique system IDs available
- Greater than 84 x 10^9 year pseudo-random encryption sequence period
- Resynchronization for late entry or fading
- Digitally controlled audio processing
- Easily passes through repeaters and voters
- Best recovered audio quality in the industry
- Selective Call (Individual & 3 Groups)
- ANI, Status, and Location Reporting
- Stolen Radio Destruct & Triangulation/ Monitoring of lost or stolen radios
- Requires U.S. State Department License for export

A ♥

K ♥ **TVS-2/Mic-Coder**

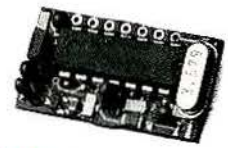


Tactical Rolling Code Voice Scrambling Microphone

- Compatible with TVS-2 scramblers
- Durable microphone with backlit keypad
- LEDs: scramble mode light, call light, & transmit light

Passes Through Voters

Q ♥ **VPU-8**



Smallest Full-Duplex or Half-Duplex Speech Inversion Scrambler

- Single code inversion scrambler
- Motorola VPA compatible
- Simultaneously scrambles & descrambles
- Crystal controlled for high stability
- Very good recovered audio quality and speaker recognition
- Single input lead takes a ground to change between scramble and clear
- Available with flying leads

Q ♥

10 ♥ **VPU-7**



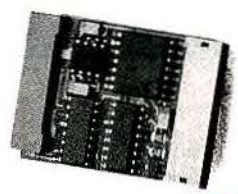
Smallest Simplex Inversion Scrambler

- Ultra-thin simplex inversion scrambler
- Single code scrambler
- Anti-aliasing input filter
- Crystal controlled for high stability
- Excellent recovered Audio Quality
- Microminiature quick disconnect connector with color coded leads for simplified installation and removal. Available with optional flying leads.

10 ♥

Best Recovered Audio

J ♥ **VPU-2**



Subminiature Tunable Voice Inversion Scrambler

- Easily tuned with high-stability 15-turn trim pot
- Anti-aliasing input filter
- Six-pole tracking output filter
- Simplex operation
- Excellent recovered audio quality
- Microminiature quick disconnect connector with color coded leads for simplified installation and removal. Available with optional flying leads.

J ♥

Passes Through Repeaters

With a Hand Like This, You Can Bet on Midian

To Order Call Toll Free: 1-800-MIDIAN'S

Telephone: (602) 884-7981

FAX: (602) 884-0422

MIDIAN

World Leader in Innovative Communications Technology

MIDIAN ELECTRONICS, INC. / 2302 East 22nd Street / Tucson, Arizona 85713

Circle (12) on Fast Fact Card

References cited in the pager servicing series

Bravo pagers

Service Manual (138MHz–174MHz) 68P81047C75-C
Service Manual (406MHz–512MHz) 68P81047C80-C
Service Manual (929MHz–932MHz) 68P81006B85-C

Bravo Plus pagers

Service Manual (138MHz–174MHz) 68P81012B20-A
Service Manual (406MHz–512MHz) 68P81012B25-A
Service Manual (929MHz–932MHz) 68P81012B30-A

Bravo Express Series:

Service Manual (929MHz–932MHz) 6881013B15-B
Service Manual (450MHz–480MHz) 6881013B10-0
Service Manual (138MHz–174MHz) 6881013B05-A

Programming equipment:

Bravo Portable Programmer NLN-3163A
Bravo Plus/Express Interface NLN-3548B
Bravo Plus Fixture/Program NLN-3640A
Bravo Express Fixture/Program NLN-3723A

For technical assistance:

Motorola Parts ID, 800-422-4210
Motorola Technical Assistance, 800-548-9954
Motorola Repair Center/DFW Pager Repair
1701 Valley View Lane, Suite A
Farmers Branch, TX 75234
214-241-1891

The "internals" of U023 contain a switchmode power supply. Essentially, a switchmode power supply is an energy transfer method. The flux energy stored in an inductor is added to energy already present on a dc power rail, using a technique called *step-up mode*.

In the case of the Bravo Plus, an oscillator operating at about 80kHz is gated to provide driving current to an output transistor. As configured, energy stored in the external inductor (L021) is momentarily placed in *series-aiding* mode with the source voltage of 1.5V. As the transistor is toggled, energy is alternately stored in L021 as the transistor saturates, and then placed in *series-aiding* mode with the source voltage as the transistor comes out of saturation. The toggled 80kHz square wave is rectified by CR021, filtered by a 10µF capacitor (C023), and decoupled by R021 and C024, providing a little more than 3V output.

The B++ output is deceptive—this is *not* the actual output of the supply, but a means of resistive tapping to provide a reference feedback voltage to be compared at the voltage reference (V_{REF}), pin 18, U023. An internal comparator is constantly checked and toggled to cause the 80kHz oscillator

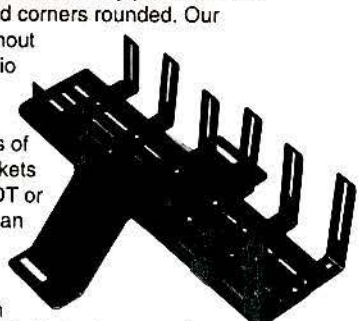
GAMBER-JOHNSON

MCS-100 SERIES

MCS-100 SERIES

The Gamber-Johnson MCS-100 Series is an economical alternative to consoles for mounting voice and data communications equipment in your Caprice or Crown Victoria.

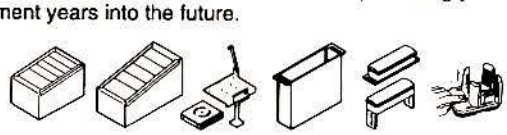
Our base is one piece, made of 3/16" electrostatically powdercoated steel. For safety, all edges are milled and corners rounded. Our design allows installation in minutes without drilling or modifying the vehicle. Our radio brackets are universal and simple to install and adjust. The 22 1/2" mounting surface gives you room for up to six sets of radio brackets, or a combination of brackets and a Gamber-Johnson MCS Series MDT or Laptop/Notebook mount. We even offer an adjustable armrest to assure an ergonomically correct work station.



The simplicity and strength of our design provides a margin of safety unsurpassed in the industry, and ease of installation which saves you time and money. Of course, the MCS-100 system is air bag friendly when properly installed, and, if desired, may be upgraded to an enclosed console protecting your initial investment years into the future.



Partial accessory sampling



For information now
CALL 1-800-GJ-MOUNT 1-800-456-6868
FAX 1-800-WE-HELPP 1-800-934-3577

GAMBER-JOHNSON
Service & Solutions™
801 Francis Street, Stevens Point, Wisconsin 54481

Circle (13) on Fast Fact Card

Andrew Innovation... It's Everywhere

Andrew offers everything you need to build the highest quality transmission line system. In addition to HELIAX® coaxial cable, Andrew also offers a complete line of connectors, cable assemblies and accessories. Each is designed and tested to reduce intermodulation (IM) and optimize the mechanical and electrical performance of your entire transmission line system, top to bottom, inside and out.

Andrew Innovation... Put It to Work for You.

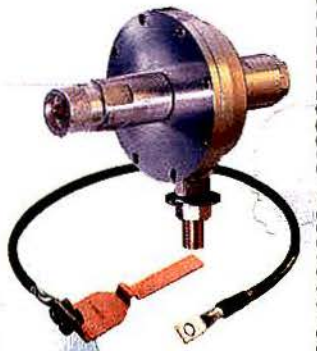


CONNECT IT

Andrew offers a wide variety of connector configurations and interface types including 7/16 DIN, 4.1/9.5 DIN and Type N connectors to accommodate any installation.

PROTECT IT

Andrew surge protectors, grounding kits and components provide the highest level of lightning protection available today. ARRESTOR PLUS™ Premium Surge Protectors provide true multi-strike capability delivering a cost effective, reliable, easy to install, no maintenance product.





SECURE IT

Transmission line installation is fast and easy with hangers designed exclusively for HELIAX® cable. Hanger Blox™ Coaxial Cable Hangers make the most efficient use of available space by arranging cable into compact, orderly units.



WEATHERPROOF IT

Andrew 3M™ Cold Shrink™ Weatherproofing Kits provide a long lasting, secure moisture barrier for cable connections and jumper-to-antenna connections with Type N or 7/16 DIN connectors.





ANDREW.
Andrew Corporation
10500 W. 153rd Street • Orland Park, IL U.S.A. 60462

Circle (14) on Fast Fact Card

To learn more about Andrew Innovation, Call our Customer Support Center at

1-800-255-1479 Ext 86, or fax us at 1-800-349-5444.

HELIAX® Coaxial Cable • RADIAX® Cable • HELIAX® Cable Assemblies • Accessories

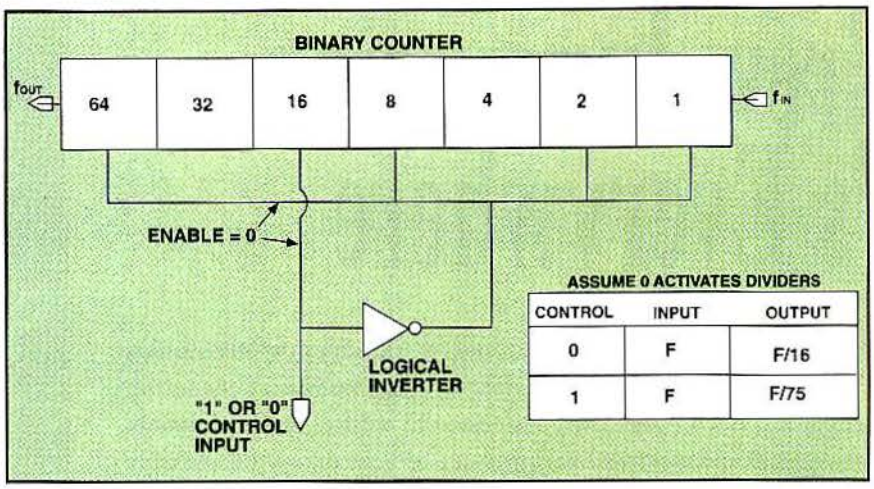


Figure 2. One method of control for the binary counter and divider stages of the Bravo Plus pager.

to provide adequate signal to keep the charge-discharge cycle across L021 operative and to maintain the required output voltage. Overall, this is a sophisticated supply, but it cannot handle much output current.

Meanwhile, back at the microprocessor . . .

Remember the information loaded from the codeplug contains both *instructional* and *mathematically derived* data. The instructional data contain responses programmed to such prompts as BEEP ON BAD DATA Y/N or SILENT MODE CHIRP Y/N. These instructional data represent bit patterns that are simple yes/no instructions.

The mathematically derived information is dependent on the capcode entered and (to some extent) by the baud (actually, bits per second [bps]) rate selected in the first screen of the programming session. As described in the November 1994 article, the capcode *mathematically* determines which *frame* will be used to seek the capcode.

In the case of the Bravo Plus and Bravo Express pagers, the baud (bps) rate also determines a division ratio that places the pager in a synchronous mode compatible with the selected POCSAG data rate.

The choice of 38.4kHz for the clock oscillator was *not* arbitrary. When divided by 75, the resulting frequency is 512Hz; when divided by 32, the resulting frequency is 1,200Hz; and when divided by 16, the resulting frequency is 2,400Hz. In any of these cases, a simple binary divider would suffice nicely to provide an accurate time base to match the baud rate of a POCSAG signal. (See Figure 2 above left.)

Those familiar with programming the Plus and the Express have long been familiar with the fact that some versions program to 512 baud or 2,400 baud, but not to both, and all of them program to 1,200 baud.

This difference is because one version of the microprocessor has both a divide-

To Reach the UnReachable

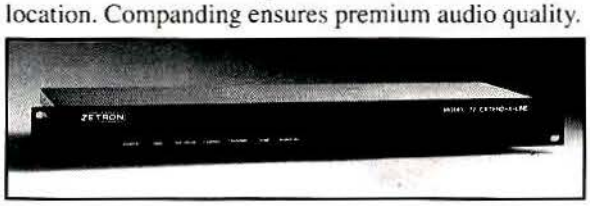


Beyond wire, beyond cells, Zetron radio telephony controllers give you cost-effective, wireless telephone service in remote locations.

A normal touch-tone telephone is all that's needed to place and receive calls into the public telephone system. No special procedures are needed. Just lift the handset and receive dial tone!

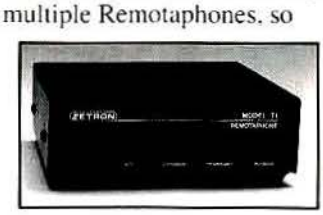
Model 72 Extend-a-Line

A pair of Model 72s establishes a dedicated full-duplex link from the end of the phone line out to a remote location. Companding ensures premium audio quality.



Model 71 Remotaphone

Simply install a Remotaphone and touch-tone telephone in each remote spot. Your DTMF-signaling phone patch can support multiple Remotaphones, so you can have low-cost telephone service anywhere. Works great with full-duplex or simplex radios!



Call today and ask for our brochure,

ZETRON®

"Rural Radio Telephony Solutions from Zetron."

Zetron, Inc. 12034 134th Ct NE, PO Box 97004 Redmond WA 98073-9704 Phone: (206) 820-6363 Fax: (206) 820-7031

Circle (15) on Fast Fact Card

"YOUR BUYER'S GUIDE REPLACES THE 10 TO 20 CATALOGS WE USED TO USE. IT'S BY FAR THE BEST I'VE EVER SEEN!"

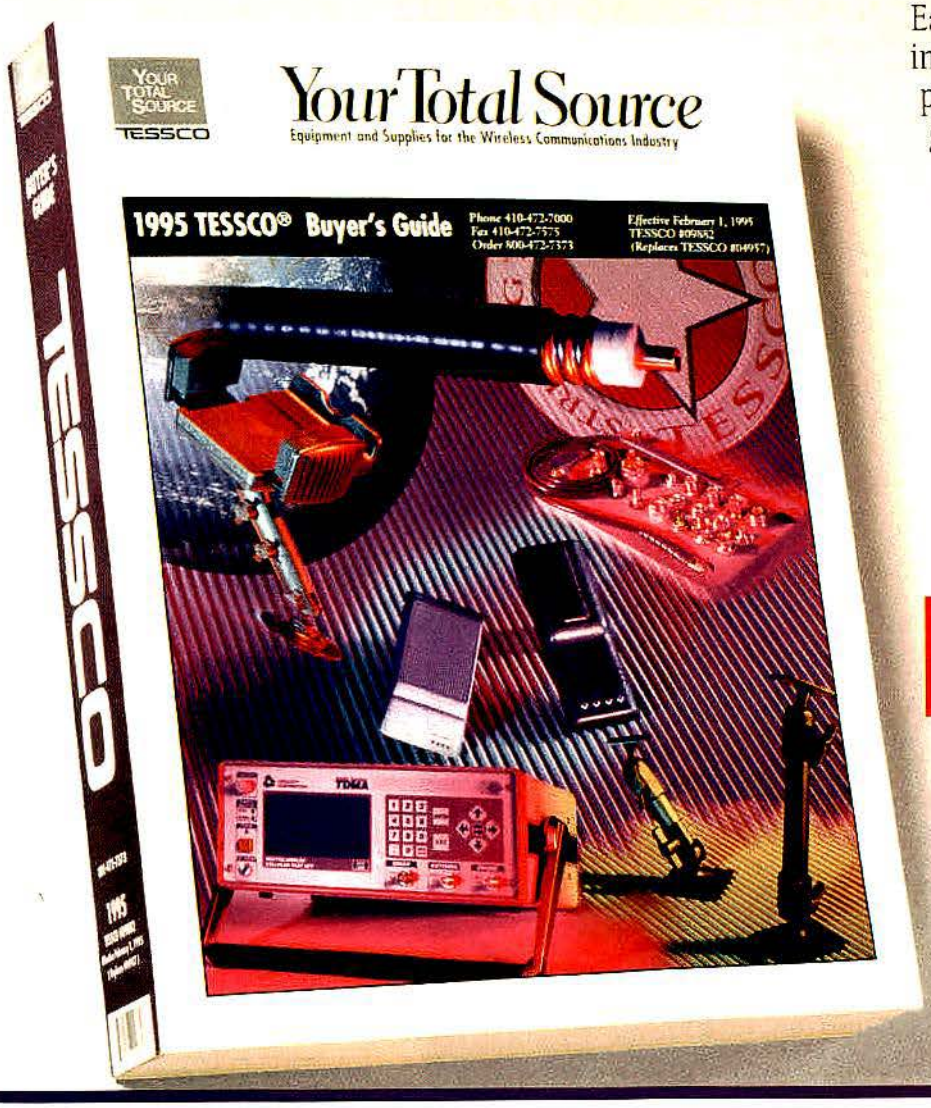
J. R. Rzucidlo
Radio/Metropolitan Communications, Inc.

12,000 Items.
Over 170 Manufacturers.
850 Pages.

Easy to use and fully indexed with complete product specs and guaranteed pricing.

Simplify your life. Call, fax or write to reserve your complimentary* copy of the wireless industry standard.

800.472.7373
410.472.7575 fax





NOT JUST A CATALOG

YOUR TOTAL SOURCE®
TESSCO

TESSCO
34 Loveton Circle
Sparks, MD 21152-5100 USA
800 472.7373
410 472.7575 fax

045

*Complimentary to qualified service organizations

by-75 and a divide-by-32 binary counter, although another version contains the divide-by-32 and the divide-by-16 binary counter. In both cases, the division ratio may be set with either a *1* or a *0* controlling the clock's output frequency. (See Figure 2.)

Further housekeeping chores (e.g., 12/24-hour time displays and vibrator on-off functions) are directed to specific addresses within the processor's memory map to be performed at the appropriate times.

The 'I'm looking for it' mode

Once past the wake-up mode, the pager goes into an alternating on-off mode, turning the receiver board on briefly and then turning it off. The length of on-off timing is governed by the bps (baud) rate determined at the programmer and is directly controlled by the division ratio just discussed.

The pager is looking for two basic signals, either the alternating "*1010 ...*," 576-bit repetition signaling the beginning of a POCSAG transmission or the unique, 32-bit "word" that contains the *frame sync code*. If the "*1010 ...*" sequence is found, the pager responds by lengthening the receiver's *on* time. If the *frame sync word* is found, the pager immediately resets the *frame counter* to zero and turns *on* at the *frame* appropriate to the capcode programmed to that pager.

Each *frame* (1 through 8) contains 64 bits organized as 32 bits for *capcode* and *parity*, and the following 32 bits contain the remaining information that will be displayed as a message, plus the same check sum.

The *capcode/parity* portion starts out with the first bit always being a zero. Bits 2 through 19 contain the capcode, and bits 20 and 21 identify the "source" of the pager call (a throwback to the day when pager calls were identified by the letters *A* through *D* to identify who was calling). It is the remaining bits' function (bits 22 through 32) to report parity tests performed on the message. These tests are used at the pager to verify accurate message reception.

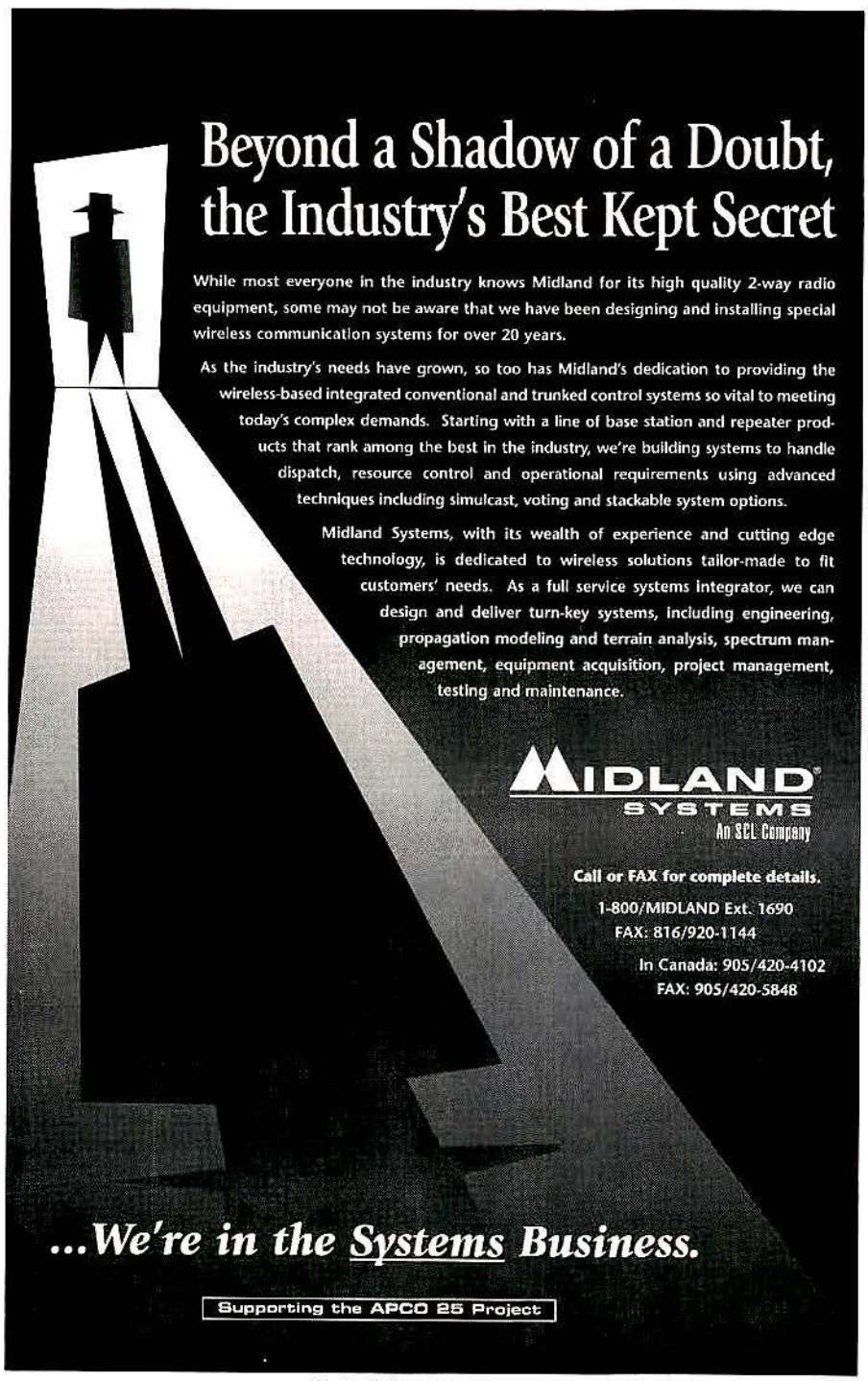
If the values in these last 10 bits are not matched by the parity values received at the pager, the message is then turned over to a decision made at the programmer. BEEP ON BAD DATA = N prevents any response from the pager. BEEP ON BAD DATA = Y allows the message to be displayed with the letter *E* filling whatever portion of the message that did not match the calculated parity values.

It was mentioned earlier that the "*1010 ...*," 576-bit alternating *preamble sequence* of the POCSAG signal is monitored by the receiver. The speed at which this sequence is sent *must* be matched by the receiver to provide synchronous detection. Unless the receiver "sees" the alternating "*1010 ...*" *preamble sequence*, it remains in its "relaxed" on-off cycle, waiting for something to happen.

Similarly, if the *frame sync* happens to be sent at the same time the pager receiver is on, a proper decoding of the frame sync signal immediately resets the *frame counter* to zero and turns the pager receiver on again at the appropriate frame. Unmatched baud rates prevent the pager from responding to any portion of the frame sync or preamble signals.

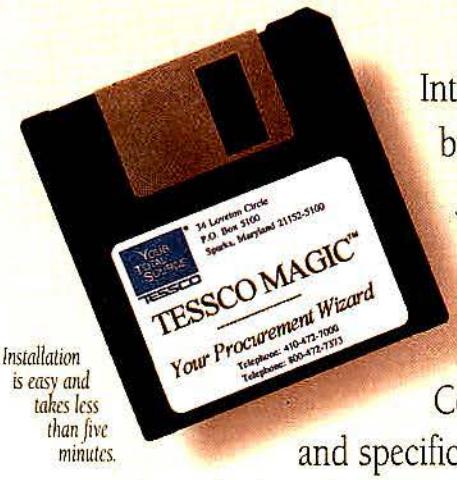
The 'Storing it away!" mode

Upon receiving and properly acknowledging a page, the pager transfers



Circle (16) on Fast Fact Card

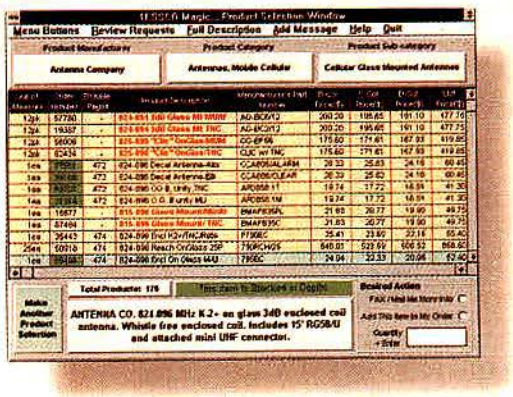
POINT. CLICK. ORDER. ANY QUESTIONS?



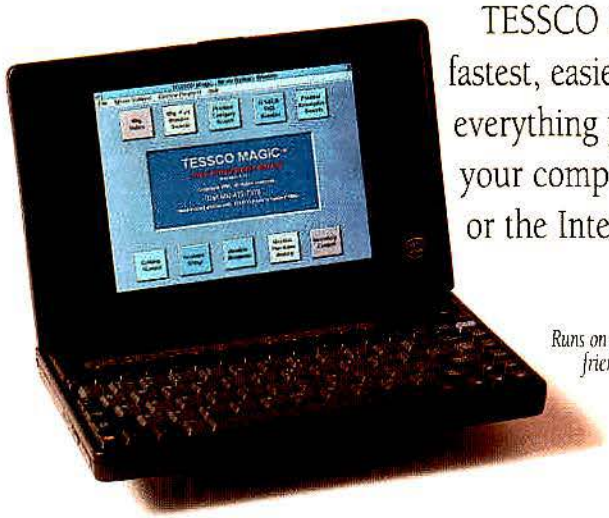
Installation is easy and takes less than five minutes.

Introducing TESSCO Magic™, the revolutionary new buyer's guide and procurement software from TESSCO. Just point and click for complete information on our entire selection of more than 12,000 wireless products from over 170 manufacturers.

Compare pricing and specifications, build an order, calculate destination and handling charges, create a purchase history, even transmit your order instantly any time of the day or night. All without so much as opening a catalog or picking up the phone.



Five search modes let you find information on any of our 12,000 products in seconds.



TESSCO Magic™. It's the newest, fastest, easiest way to find and purchase everything you need. And only TESSCO has it. To reserve your complimentary* copy, contact us today via phone, fax or the Internet.

Runs on any 386 computer in user-friendly Microsoft Windows™.

YOUR TOTAL SOURCE
TESSCO

TESSCO
34 Loveton Circle
Sparks, Maryland USA 21152-5100
800.472.7373
410.472.7575 fax
http://www.tessco.com

046

*Complimentary to qualified service organizations. ©1995 TESSCO Technologies Incorporated. Windows is a trademark of Microsoft Corp.

D.T.M.F. SIGNALLING

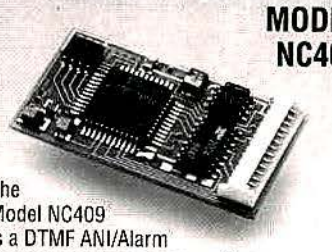
For interconnect and remote control applications

MODEL NC401



The Model NC401 is a micro-miniature DTMF decoder, designed for selective control of local or remote applications. Measuring .80"W x 1.37"L x .23"H, the NC401 combines three distinct, multi-addressable decoders offering multiple user-configurable functions. All programmed features are stored in non-volatile E2Prom memory and are easily programmed by means of a conventional DTMF encoder or the Model NC500 Universal/P.C. programmer. This highly engineered decoder is ideal for portable radio applications having limited space for accessories. The NC401 comes complete with micro-miniature 14 pin header and 12" color coded cable assembly. For FREE detailed information ask for the NC401 user's manual.

MODEL NC409



The Model NC409 is a DTMF ANI/Alarm status encoder and companion product to the Model NC401 DTMF Decoder designed to automatically or manually generate any of the 16 DTMF characters. The NC409 features 15 memory locations of up to 30 digits each plus last number redial and multiple user-configurable functions. Programming is easily performed by means of a 12 or 16 button "X-Y" keypad with common ground or the Model NC500 Universal/P.C. programmer. The NC409 measures .85"W x 1.36"L x .165"H and comes complete with micro-miniature 14 pin header and 12" color coded cable assembly. For FREE detailed information ask for the NC409 user's manual.

For detailed information or product catalog call 1-800-874-8663 or Fax 916-477-8403

NORCOMM™ DATA SIGNALLING PRODUCTS

12438 Loma Rica Dr., Grass Valley, CA 95945

Circle (17) on Fast Fact Card

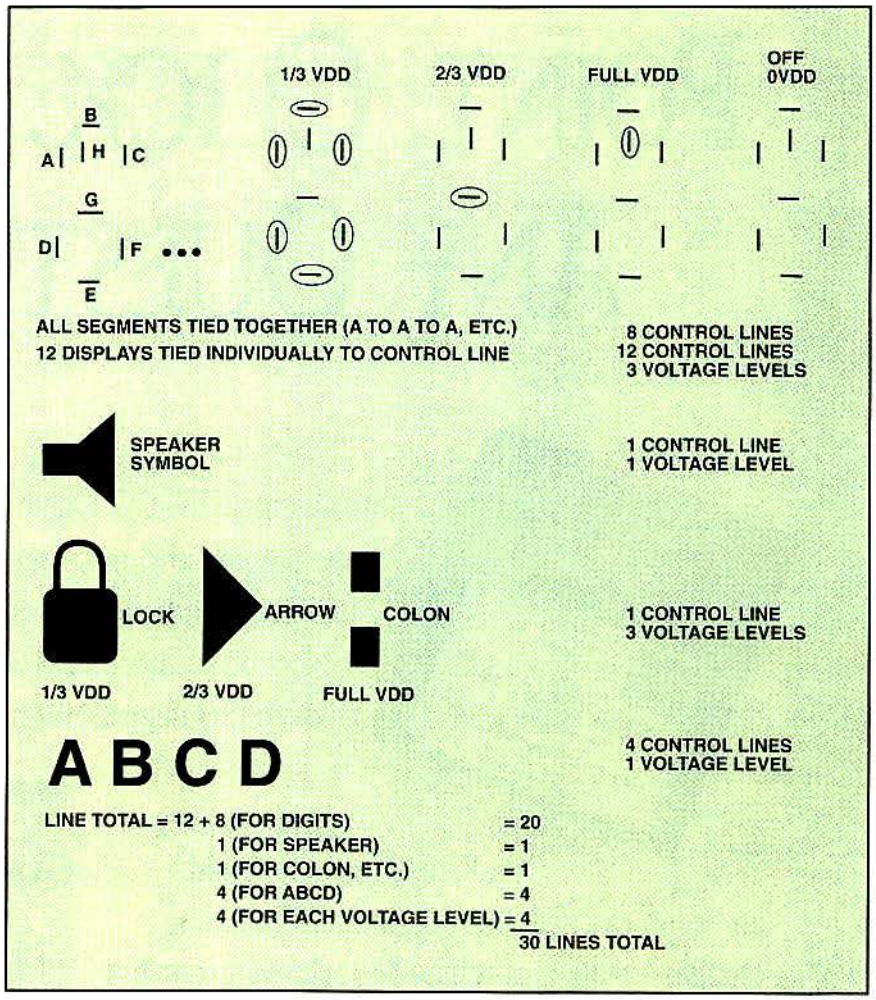


Figure 3. The liquid crystal display (LCD) consists of 12 eight-segment displays, eight special-function displays (arrow, speaker, lock, colon, A, B, C and D) and the "wake-up" display (all segments, all displays). These displays are controlled by 30 active connections between the output of the microprocessor and the display.

the 32-bit message to electronic memory, where it is stored in RAM (random access memory). The RAM has enough capacity to store 16 numbers plus the arrival time of the page. If it may be assumed that 32 bits are used for the message, and 32 bits are used for the time-clock, then a 64 bits would be used for each message-clock combination. With 16 message-clock combinations, 1,024 bits would be needed in RAM to contain all of the messages. When the memory is full, an *overflow* message is generated.

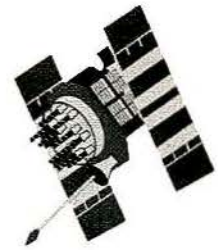
Using the *lock/unlock* feature, several messages may be "locked" into memory. This action means that the remaining "unlocked" memory is used to handle incoming messages, preventing overwrites. Associated with each locked message is a padlock icon, indicating the locked condition. Removing the locked condition involves displaying the locked number or locked time display and pressing the black selector switch to remove the padlock symbol. RAM performs its own housekeeping by shifting memory contents up to the newly opened space and opening the bottom of RAM memory to allow a new message to occupy the newly opened 64-bit area.

New messages arrive at the Bravo Plus in an unlocked condition but may be maintained in RAM (depending upon how the pager is programmed), in which case the Bravo Plus may be turned off with no loss of messages. It is not until the *clear all* message is enacted (by pushing the gray push-button) that all unlocked messages are cleared from RAM. All locked messages must be unlocked before they become erasable.

Translating and displaying

The display consists of 12 eight-segment displays, eight special-function displays

Introducing



SKYMARK®
VehicleTracker

Finally an Affordable GPS Based AVL System

Everyone, it seems, is talking about the Global Positioning System, or GPS. GPS is a recent innovation in precise low-cost satellite-based positioning technology. And, when installed in a two-way equipped vehicle, GPS-based Automatic Vehicle Location (AVL) systems are capable of streamlining fleet operations by showing dispatchers the accurate location of every vehicle in the fleet. Now Cimarron brings GPS/AVL technology to radio-based fleet vehicles, simply and without the "Big System" costs.

High Tech, Low Cost

We have made SKYMARK economical enough for virtually any dispatch operation to justify. We use ***exact electronic copies*** of the dispatcher's existing maps, on a simple, clear computer display. Plus our SKYMARK AVL system is a complete package (not just some pieces), and it can be installed and maintained by any radio service shop.

Your Fleet, Your Radios, Your Maps & Your Budget

SKYMARK VehicleTracker is geared to existing fleet management operations. Our low-cost vehicular GPS receiver interfaces to our micro-miniature data modem, that installs quickly *inside* the mobile radio. The modem's emergency "panic button" enhances personal safety and command outputs provide remote control in the vehicle.

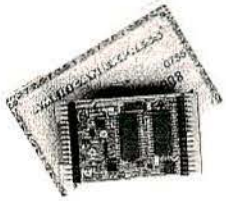
At the dispatch center a compact radio channel controller receives vehicle location data from each unit with minimal impact on existing voice traffic. The data is then passed in real-time to a PC displaying an exact electronic copy of the paper maps the fleet uses every day. The location, unit ID, speed and direction, plus the "closest car" to an incident or assignment are shown clearly on the map display.

And There's More!

So call us and we'll show you how SKYMARK can provide a simple, economical and straight-forward AVL solution to fit your needs.



The mobile receives signals from GPS satellites.



SKYMARK's Mobile RF modem fits inside the mobile radio.

The vehicle ID, speed and direction are sent to the base display



PC running VehicleTracker® Software

CIMARRON TECHNOLOGIES

934 South Andreasen Drive, Suite G, Escondido, CA 92029
Call toll-free 1-800-487-7184 or 619-738-3282.

SKYMARK and VehicleTracker are registered trademarks of Cimarron Technologies

Circle (18) on Fast Fact Card

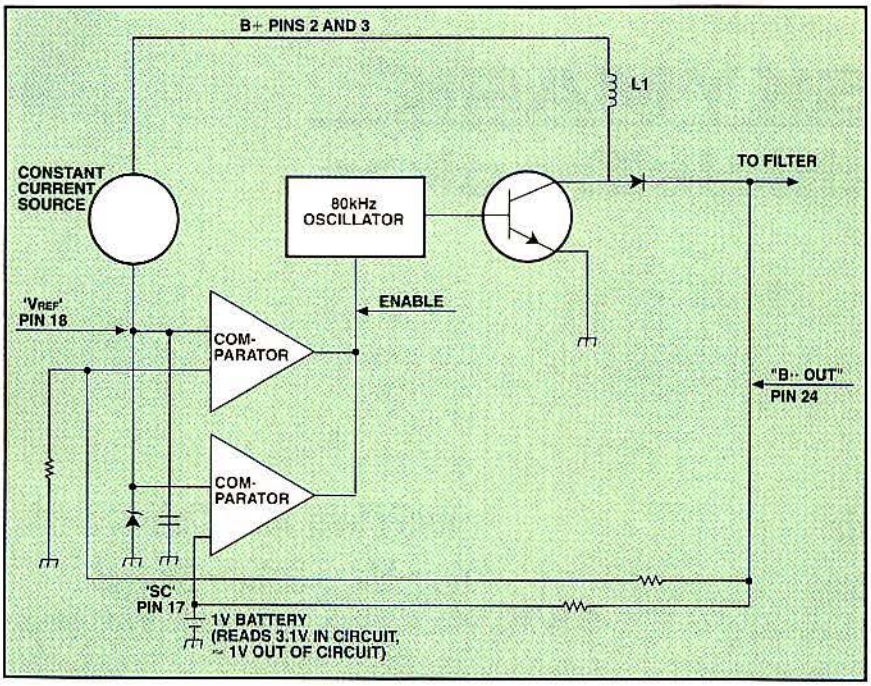
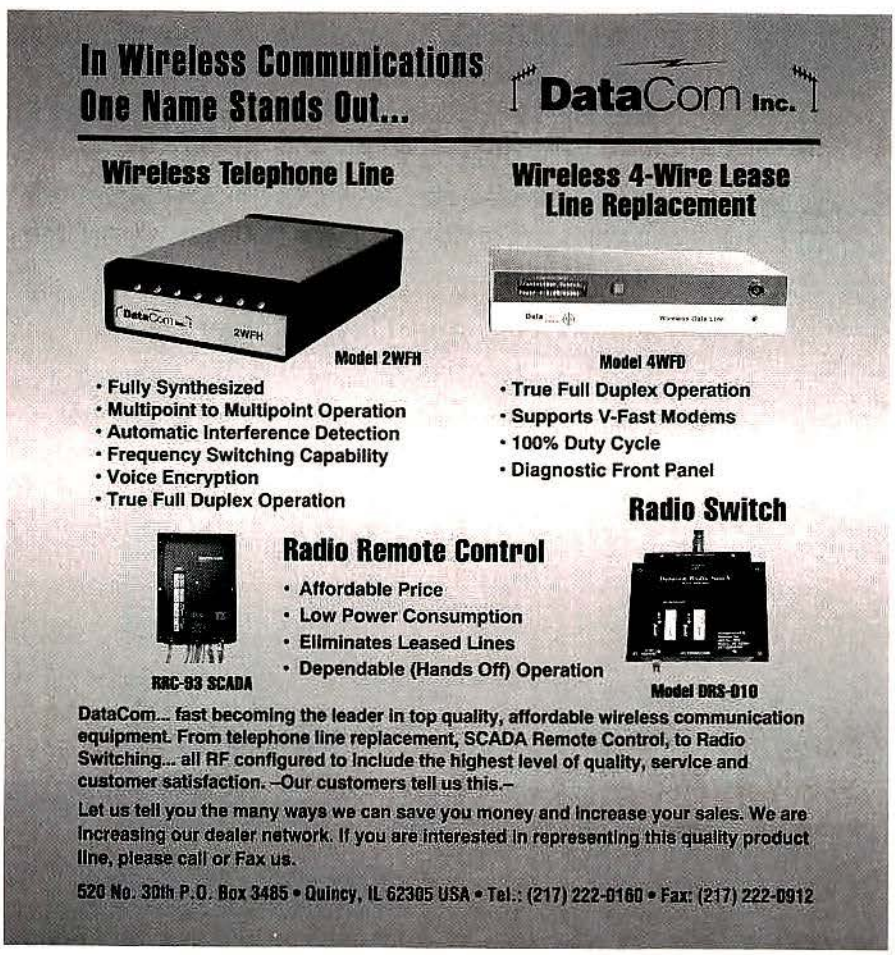


Figure 4.The Bravo Express U2 power supply chip uses an onboard battery to maintain the VCC voltage to the real-time clock when the power has been shut down, as shown in this block-and-equivalent circuit diagram. This single feature allows an internal timer to compare *master on* and *master off* times (set by the user) and to transfer control to or from the AAA-size battery as a source of main power.



Circle (19) on Fast Fact Card

(arrow, speaker, lock, colon, A, B, C and D), and the "wake-up" display (all segments, all displays). These displays are controlled by 30 active connections between the output of the microprocessor and the display.

There are four "backplane" voltage levels and control lines. Individual voltage steps of 0, 1/3, 2/3 and full VDD are applied to these four lines, which activate separate LCD planes within the crystal display. *Zero* equals *off*.

There are 12 eight-segment displays. Assuming that a typical multiplex arrangement is used, these 12 displays would be controlled by 8 + 12 = 20 lines. These lines are used in conjunction with the four backplane voltages to provide numeric data. (See Figure 3 on page 24.)

The *speaker* display uses a single control line and a voltage level to display the symbol to the screen.

Lock, arrow and *colon* share a single control line and use the available three levels of display planes to darken the appropriate symbol. Otherwise, the set of displays remains inactive (VDD = 0).

Letters *A, B, C* and *D* are controlled by four control lines and a single display plane/voltage level.

The line total equals the following:

12 + 8 (for digits) = 20
1 (for *speaker*) = 1
1 (for *colon, etc.*) = 1
4 (for *A, B, C* and *D*) = 4
4 (for voltage levels) = 4

30

At best, the schematics are ambiguous ... These are multiplexed displays, which means the average service shop is not going to be able to see (let alone fully diagnose) potential problems with the output from the microprocessor chip. If the display shows "stray" portions of some other voltage level's segments, replacing the contact strip and display often cures the problem. (The conductive ribbon might be touching an adjacent contact next to its own.) LCD replacement requires the proper set of tools and a bit of patience, but being able to do it is often worth the investment.

Notes on the Bravo Express

Refer to the appropriate Motorola schematics.

The previous information largely applies to the Bravo Express logic boards with the following exceptions:

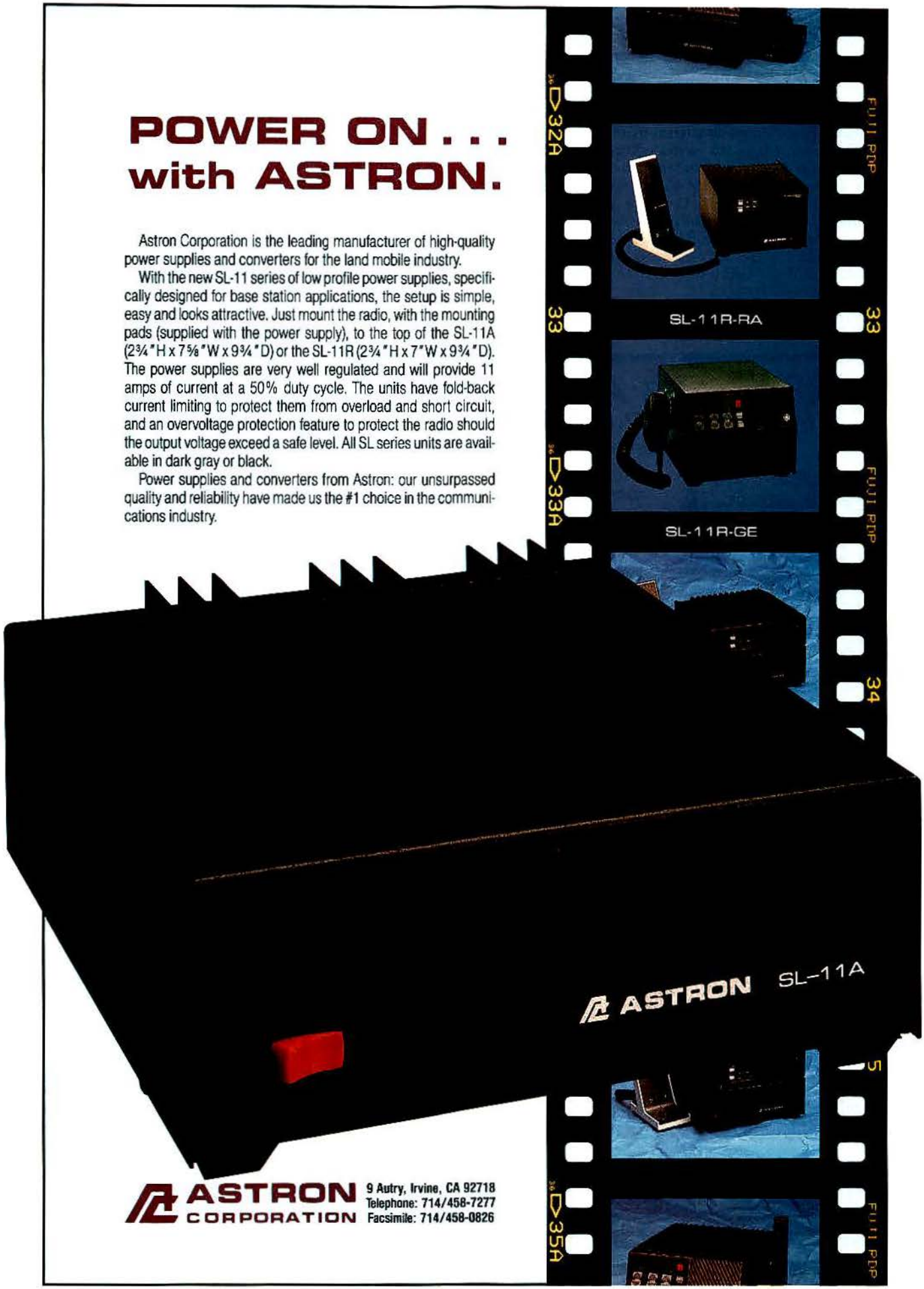
First, the power supply chip uses an onboard battery (see pin SC of U2) to maintain the VCC voltage to the real-time

POWER ON . . . with ASTRON.

Astron Corporation is the leading manufacturer of high-quality power supplies and converters for the land mobile industry.

With the new SL-11 series of low profile power supplies, specifically designed for base station applications, the setup is simple, easy and looks attractive. Just mount the radio, with the mounting pads (supplied with the power supply), to the top of the SL-11A (2¾"H x 7⅝"W x 9¾"D) or the SL-11R (2¾"H x 7"W x 9¾"D). The power supplies are very well regulated and will provide 11 amps of current at a 50% duty cycle. The units have fold-back current limiting to protect them from overload and short circuit, and an overvoltage protection feature to protect the radio should the output voltage exceed a safe level. All SL series units are available in dark gray or black.

Power supplies and converters from Astron: our unsurpassed quality and reliability have made us the #1 choice in the communications industry.



ASTRON CORPORATION
9 Autry, Irvine, CA 92718
Telephone: 714/458-7277
Facsimile: 714/458-0826

Circle (20) on Fast Fact Card

clock when the power has been shut down. (See Figure 4 on page 26.) This single feature allows an internal timer to compare *master on* and *master off* times (set by the user) and to transfer control to or from the AAA-size battery as a source of main power. Compare the pinouts of U025 in the Bravo Plus with the pinouts of U1 in the Bravo Express. U025 and U1 are the same chip, just loaded with different software. U023 equals U2, and U024 equals U3 but the same programming software does not work on both pagers.

Second, the *Port A* register is configured differently, but this difference is largely just a matter of switch placement and the addition of *mode* and *select* switches to step the user through various features available in the Express.

Third, geographical territory on the logic board is limited. Only someone with a pair of eagle eyes and nerves of steel should attempt repairs to this board!

Acknowledgement

I would like to thank the management and staff of Toltec Communications Resources, Pasadena, TX, for their help with this project. Tel.: 713-947-7660.

Pager servicing series

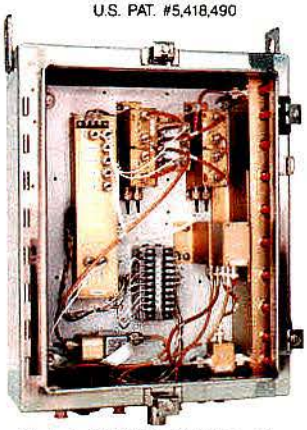
Part 1: "Build a Shielded Room," January 1994. (All pagers.)
Part 2: "Build an 'IFFER,'" February 1994. (Bravo, Bravo Plus, Bravo Express.)
Part 3: "Frequencies, Coding Formats," March 1994. (Bravo.)
Part 4: "From Bench to Programmer," April 1994. (Bravo.)
Part 5: "The Receivers," May 1994. (Bravo.)
Part 6: "Elegant Simplicity," June 1994. (Bravo.)
Part 7: "Problems in Paradise," July 1994. (Bravo.)
Part 8: "406MHz–512MHz Receivers," August 1994. (Bravo.)
Part 9: "150MHz Receivers," September 1994. (Bravo.)
Part 10: "Tales Crystal Filters Tell ...," October 1994. (Bravo, Bravo Plus, Bravo Express.)
Part 11: "Microprocessor Board," November 1994. (Bravo.)
Part 12: "Headaches (and Some Aspirin)," January 1995. (Bravo.)
Part 13: "Mixed Signals," February 1995. (Bravo.)
Part 14: "Essential Differences," April 1995. (Bravo Plus, Bravo Express.)
Part 15: "And You Shall Receiver Knowledge ...," June 1995. (Bravo Plus, Bravo Express.)
Part 16: "The Information Highway," July 1995. (Bravo Plus, Bravo Express.)
Part 17: "450MHz Receiver Boards," August 1995. (Bravo Plus, Bravo Express.)
Part 18: "Logic/Decoder Boards for Bravo Plus, Bravo Express," November 1995. (Bravo Plus, Bravo Express.)

Back issues printed within the past two years can be ordered for $5 each, postpaid. Call customer service at 800-441-0294. Issues printed more than two years ago and individual article photocopies are unavailable from the publisher. Individual photocopies of articles printed since January 1983 can be ordered from UMI Information Store, 800-248-0360.

Editor's note: The final installment in this article series will appear in the January 1996 issue. David Ludvigson has made an arrangement with the publisher such that, when the series is complete, he will offer a compilation of all the articles for purchase. Ludvigson also is preparing a videotape with pager servicing information based on his articles.

422-Series *Auto-Backup*™
Tower-Mounted Preamplifier Systems
For the 806-960 MHz Frequency Range

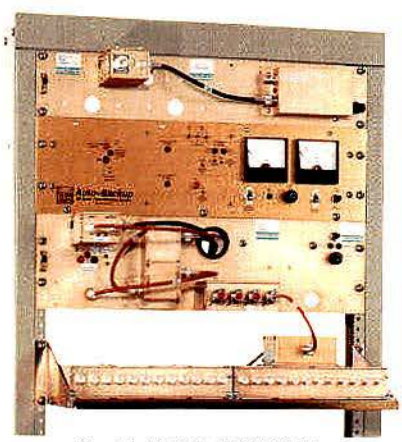
U.S. PAT. #5,418,490



Model 422-86A-07-18-117
Auto-Backup Tower-Mounted
Preamplifier System

- ***Auto-Backup*** *system (US and other patents pending) monitors primary preamplifier and switches to backup preamplifier in case of primary failure.*
- *Secondary preamplifier is normally off-line and isolated from events that would destroy both amplifiers in competitive parallel-connected, "redundant" systems.*
- *High-selectivity, six- to ten-section combline preselectors for trunking, AMPS and GSM bands in 5, 10, 12.5, 15, 18 and 25 MHz bandwidths.*
- *Multiple power supplies with automatic battery backup for maximum system reliability.*
- *Ground-level control panel provides positive diagnostic and power backup capabilities via a separate DC cable.*
- *High-performance bipolar preamplifiers feature low noise figure and high output intercept point.*
- *High-performance receiver multicoupler output amplifiers have a third-order output intercept point of +43 dBm to assure a large dynamic range.*

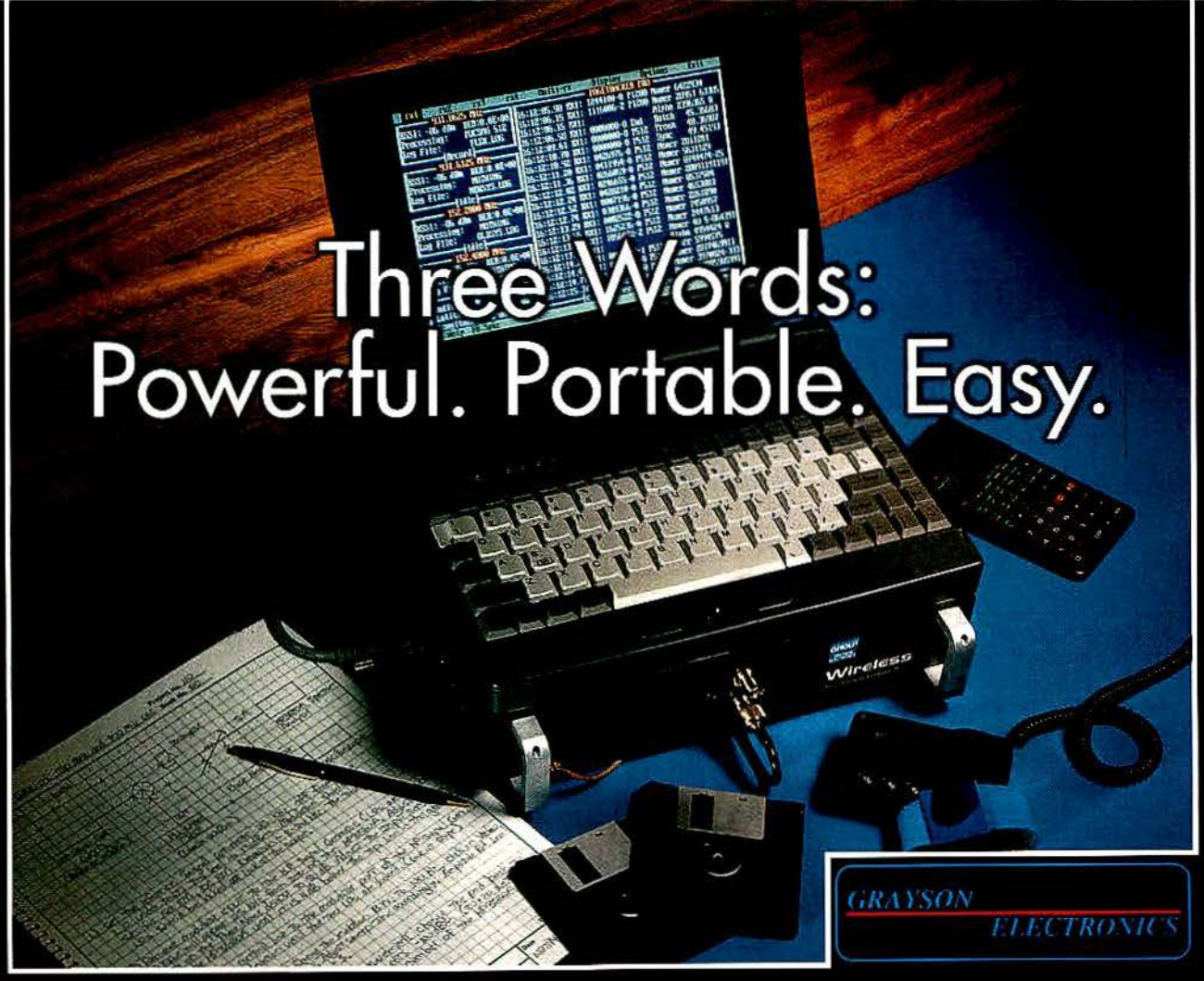
Auto-Backup...
The no-compromise receiving system for today's world.



Model 42-86A-42-24-117
24-Channel Receiver Multicoupler with
422-Series Auto-Backup Control
Panel and RF Test Panel

TX RX SYSTEMS INC.
MULTICOUPLERS - SIGNAL BOOSTERS
DUPLEXERS - CAVITY FILTERS - RF SYSTEM PRODUCTS
8625 Industrial Parkway - Angola, New York 14006
Telehone (716) 549-4700 - Fax (716) 549-4772

Circle (21) on Fast Fact Card



One Tool: PAGETRACKER Pro™, The Paging Industry's New Standard in Wireless Measurement Instruments.

You want one instrument for all your network test and analysis needs. Your customers want quality paging service. Revolutionary PAGETRACKER Pro is the answer.

Advanced PAGETRACKER Pro packs a range of features and measurement capabilities never before available in a single, easy-to-use piece of test equipment. It reads all paging activity — including FLEX — in real time so you can see what's actually going out over the air instantly. Four easily tunable, independent receivers let you take up to four different measurements on a single channel, or the same measurement on up to four different channels. High-performance, ultra-stable receivers provide reliable, accurate measurements.



At under 10 pounds, PAGETRACKER Pro is a powerful, portable WMI that decodes all POCSAG, NEC, GOLAY, and FLEX paging signals virtually anywhere in your coverage area.

You can simultaneously measure signal strength, BER, traffic, interference and more, with comprehensive measurement capabilities like throughput, traffic statistics and batch efficiency. A NAVTRACKER GPS receiver provides multiple test results with position stamps to dramatically improve your troubleshooting. PROMAP® software automatically plots those results as a color map for a virtual blueprint of your system's strengths and weaknesses.

One tool. One company. One call. Contact Grayson Electronics today at 1-800-800-7465 to find out how PAGETRACKER Pro can help solve potential system problems before they become problems for your customers.

ALLEN TELECOM GROUP
GRAYSON ELECTRONICS
Division

306 Enterprise Drive
Forest, VA 24551
FAX 804-385-7692

PAGETRACKER Pro is a trademark and PROMAP is a registered trademark of Allen Telecom Group Inc.

Your Wireless Connection.

Circle (22) on Fast Fact Card

How mobile radio fading affects data transmission

Part 1—An intuitive understanding of RF fading is possible without complex mathematics and statistics. Radio signal reflections can have positive effects as easily as negative effects. Packet length makes a difference.

By Barry L. Dorr

Most of us in the mobile communications industry are aware of the effects of RF signal fading. As mobile data systems become more commonplace, these effects are becoming more important. Multipath, delay spread, coherence bandwidth, Rayleigh fading and Doppler frequency are terms used to describe signal fading. The following information explains the basics of fading and the terminology. A second article describes how well-designed data modems and systems allow data transmission over fading channels.

The basics

Radio waves are reflected by stationary objects (e.g., buildings) as well as moving objects as shown in Figure 1 above right.

Dorr is an independent consultant in Carlsbad, CA. He specializes in modem design, communication system design and digital signal processing algorithm development. Tel. 619-944-3968.

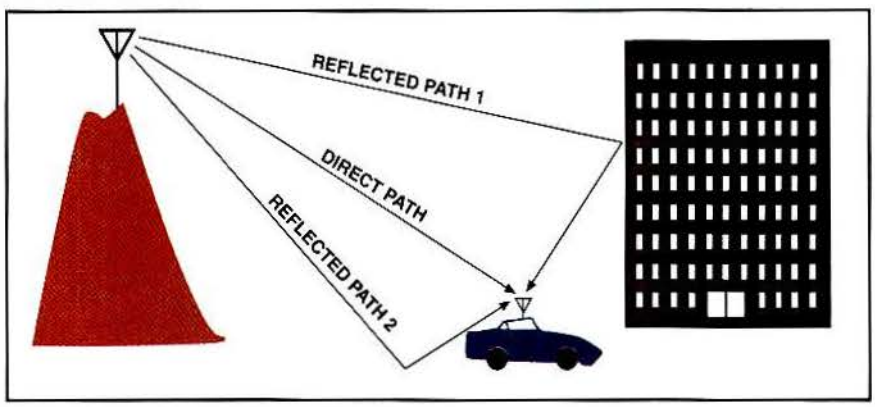


Figure 1. A specific example of multiple reflected and attenuated signals arriving at a receiver. A direct ray and two reflections are shown. A direct ray and six reflections are used for the example in the text.

Reflections have positive and negative effects: On the positive side, a reflection may allow reception when the direct, or line-of-sight, path is blocked. On the negative side, receivers often pick up the line-of-sight signal *and* reflected versions of the signal. Compared to the line-of-sight signal, reflected signals usually are delayed slightly and attenuated. Because multiple reflected signals enter the receiver, the term *multipath fading* often is used to describe this phenomenon.

Different frequencies and propagation conditions produce various multipath

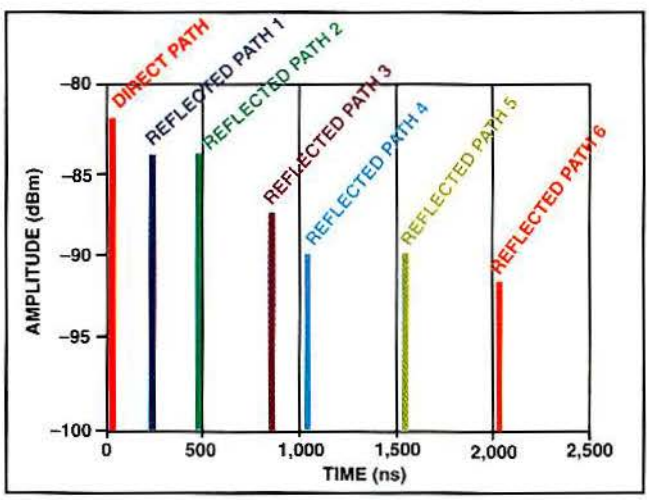


Figure 2. Received signal envelope amplitude vs. arrival time for the reflected signals shown in Figure 1. The direct-path signal reaches the receiver at time = 0.

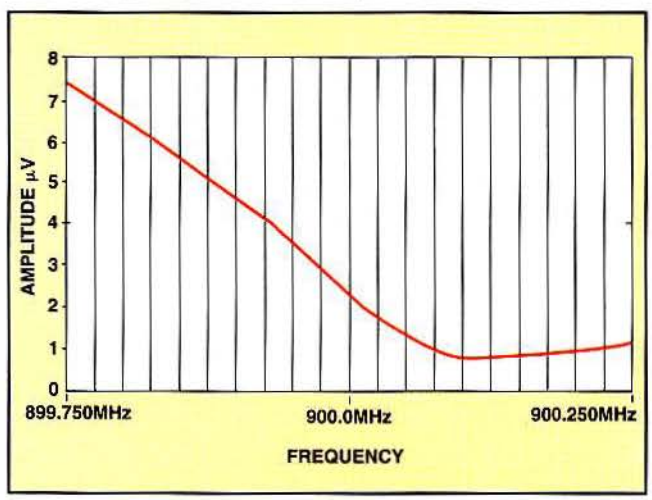


Figure 3. Received signal amplitude vs. frequency for reflected signals shown in Figure 1. Note that the frequency increments are spaced by 25kHz.

THERE ARE MANY REASONS TO SWITCH TO LARSEN.

Superior mechanical durability... greater transmit range... more efficient RF designs... toll-free service and order-entry hotlines... best warranty in the business... fast turnaround on special orders... we listen to your input and act... satisfaction always guaranteed...

INCLUDING PUTTING YOUR OLD ANTENNAS TO BETTER USE. →



Read between the lines and you'll begin to see why Larsen antennas are the best in the business. And why we're the clear choice for dealers and users worldwide. Now that you've got the itch to switch, scratch it by calling 800-426-1656. Fax: 360-944-7556.

Larsen®
The Clear Choice™

Circle (23) on Fast Fact Card

effects. For example, a busy street with surrounding buildings would tend to have many reflections, whereas an unobstructed radio path in the desert would have few. A term used to quantify multipath effects is *delay spread*. Delay spread is the amount of time required for most of the reflections of a signal to reach a receiver.

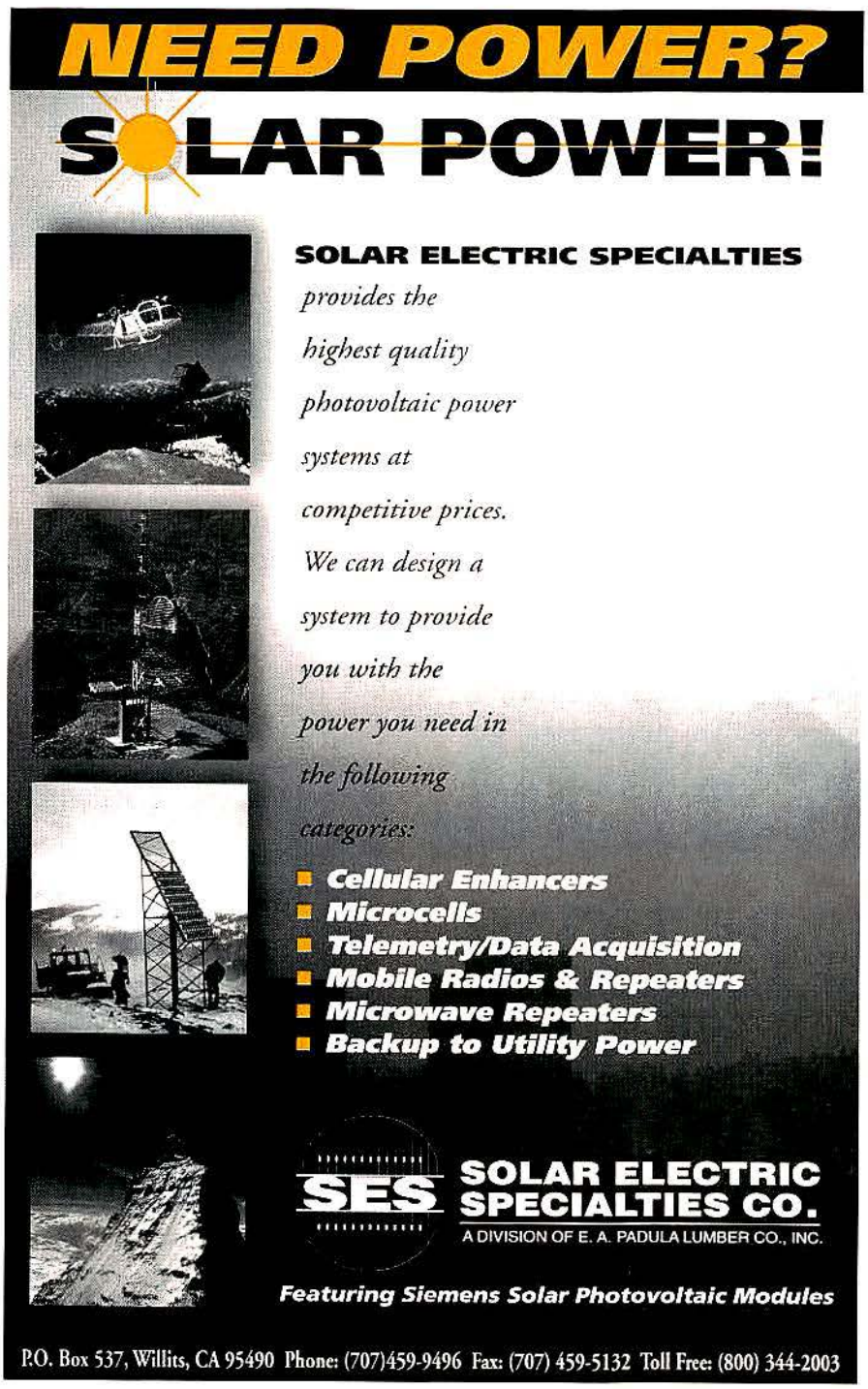
To illustrate further, consider a specific example of a static fading condition. This example shows a *specific* case of a *random* process. (The concept of fading is well-illustrated by this example; nevertheless, communication system designers normally use complex statistical analysis to describe these effects.) In Figure 1, a short burst of RF energy is transmitted from the base station. The envelope of the signal seen by the receiver is shown in Figure 2 on page 30. Note that all of the energy is received within a 2,500ns (2.5μs) window. To determine delay spread accurately, many data points (obtained with the vehicle in diffe ent places) must be averaged. A typic value of delay spread for a 900MHz signa in an urban area is 2.5μs.

Multipath fading also limits the band width of data signals that can be transmit ted over a channel. When the delayed anc attenuated reproductions of the line-of-sight signal are received, some add constructively and some cancel each other by adding destructively. Suppose that the frequency of the unmodulated carrier from the base station in Figure 1 was varied and the received signal envelope was measured at the mobile. The result would be the plot shown in Figure 3 on page 30. Data signals are composed of many frequencies. Figure 3 shows that any data signal wider than several hundred kilohertz probably would be distorted by this channel. For a given channel, the bandwidth over which the magnitude and phase stay relatively constant is the *coherence bandwidth*. As with delay spread, to determine coherence bandwidth accurately, many data points (obtained with the vehicle in different places) must be averaged. A typical value for coherence bandwidth for an 900MHz signal in an urban area is 150kHz. A wider data signal probably would need some *equalization* to flatten the channel.

For a given channel, the bandwidth over which the magnitude and phase stay relatively constant is the coherence bandwidth.

Marks on Figure 3's horizontal axis represent 25kHz increments. The figure shows that coherence bandwidth normally is not a problem with channels as they currently are assigned at 900MHz. For higher bit-rate data services, (such as personal communications services [PCS]) coherence bandwidth will become one of the primary bit-rate constraints because equalizers will raise the cost of subscriber equipment significantly.

If the vehicle in Figure 1 were moved to another location, the curves in Figures 2 and 3 would change somewhat. If the vehicle was moved to many locations and the received signal strength was measured at each location, the data would have a Rayleigh distribution as



Circle (24) on Fast Fact Card

100th anniversary
Your Global Partner for the 21st Century

Now you can leave the stacks of expensive, complex equipment back at the lab and get the job done at a fraction of the time and cost. **Anritsu Wiltron's Site Master** has all the capability you need to commission an antenna system right at your fingertips, including: **•Precision VSWR and Return Loss measurements •Accurate fault location •Immunity to live site interference •Frequency range that covers all PCS/PCN and cellular bands.**

Site Master incorporates advanced measurement and analysis performance that other tools can't touch. Its exceptional noise immunity means accurate measurements at live sites. Once you've made the measurements, powerful software helps you quickly track down faults, monitor RF performance over time, and view data in Smith chart format.

If you want to commission your sites for a fraction of the cost, size and weight of more complex systems, call us today for more information or a hands-on demonstration of the most easy-to-use, portable cable and antenna tester available.



With Site Master, you'll no longer have to haul your TDR, spectrum analyzer/tracking generator or network analyzer to a site.



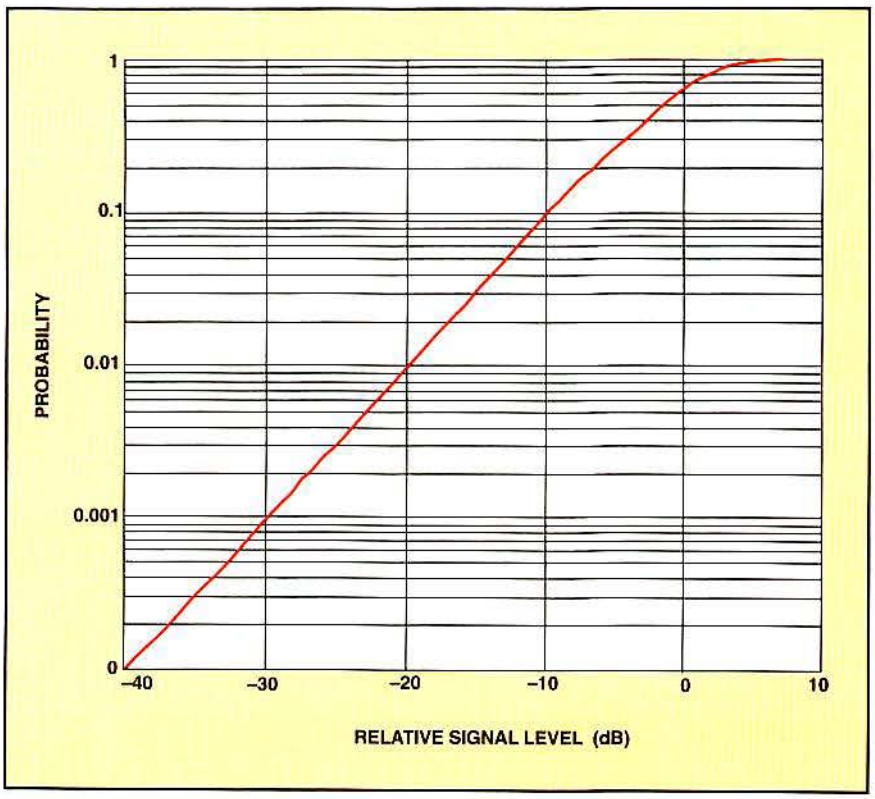
Anritsu Wiltron

All those who want a better way to commission sites, raise your hand.



United States: (800) 230-2972, Canada: (613) 828-4090, Europe: 44 (1582) 418853, Japan: (03) 3446-1111, Asia-Pacific: 81 (3) 3440-2770, South America: 55-21-286-9141, Singapore: 65-2265206

Circle (25) on Fast Fact Card



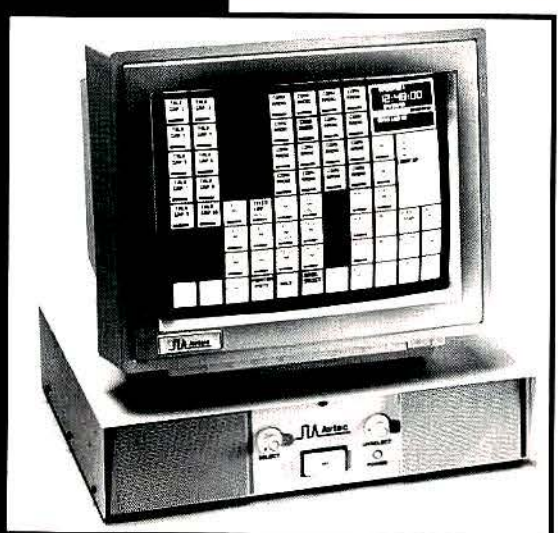
shown in Figure 4 to the left.

Moving-vehicle fading effects

As the vehicle in Figure 1 moves past reflective objects, reflections appear and disappear. Also, the lengths of the reflected paths change. Another effect is that Doppler shift causes the different paths to arrive at slightly different frequencies. The overall result is that the amplitude and phase of the received signal are constantly changing. If the base was sending an unmodulated carrier, the received signal level would vary randomly. If many samples of the received signal envelope were measured, they would follow the Rayleigh distribution shown in Figure 4. The received signal level fluctuations occur mostly at the Doppler frequency, which is a function of the RF frequency and the vehicle speed as shown in the following equation.

Figure 4. Cumulative Rayleigh distribution. From this curve you can determine the probability that the instantaneous received signal level (RSL) will be attenuated below the mean RSL by a given amount. As an example, the probability of the received signal being less than 20dB below the average level is 1%.

DSPatch—The World's Most Advanced Digital Switch For Voice Communications



Utilities, airlines, railroads, public-safety, military and other government agencies worldwide have come to rely on Avtec for advanced, high-capacity console solutions for integrated radio/telephone systems. DSPatch is a color touchscreen console system that employs Digital Signal Processors (DSP's) at every line and workstation. Its distributed architecture ensures instant responses, even in large systems. DSPatch may be configured to support from 32 to 1,024 external lines or operator workstations.

Features include:

- User configurable screens
- Conventional or trunked radio
- ANI with call queue
- Multi-format paging
- Simultaneous conferences
- Many more

DSPatch32, a 32-port system, is available for smaller applications.

Call, fax or write for additional information or a budgetary proposal.

Avtec

4335 Augusta Highway
Gilbert, SC 29054 USA
Phone: (803) 892-2181
FAX: (803) 892-3715

Circle (26) on Fast Fact Card



It's your move.

Need a strategy for moving from 2 GHz?

With California Microwave, you can minimize risk and be sure of getting where you need to be. Today into tomorrow.

Our 6 GHz radios cover the broadest capacity ranges you can find in digital and analog microwave. You'll find high performance at 10 GHz. And our light density products cover your last mile.

Add to this transmission engineering. System design. Installation. Training. You can move with real confidence.

For our complete information package of solutions for PCS relocation, call California Microwave today. We'll make your move a smart move. 1-800-999-1920.

See us in Booth #618 at WirelessWorld '95

CALIFORNIA MICROWAVE

making the smart move

2 GHz

Circle (27) on Fast Fact Card

$$f_d = \frac{v}{\lambda}$$

where:

f_d = Doppler frequency

v = vehicle speed in meters-per-second

λ = carrier wavelength in meters

Putting it all together

As an example, for a 900MHz carrier and a 40mph vehicle speed, the Doppler frequency is 53.64Hz. The transmitted signal is an unmodulated carrier. A sample plot of the receive signal level at the mobile is shown in Figure 5 to the right. As expected, the fluctuations roughly correspond to the Doppler frequency. In addition, note that the fluctuations all have different depths.

Figure 5 provides insight about data transmission under these circumstances. As a rough approximation, suppose that if the received signal level was below −110dBm, the data modem could not decode bits; above this threshold, no errors would occur. If no error correction were used, then packets exceeding 50ms probably never would be decoded by the receiver. Conversely, extremely short packets would arrive reliably. This difference explains why some vehicular data modems use interleavers and powerful coding techniques and other modems achieve high performance with no error correction whatsoever.

Next: Several practical methods used by data modems for passing data in the presence of fading, and practical methods for establishing system performance.

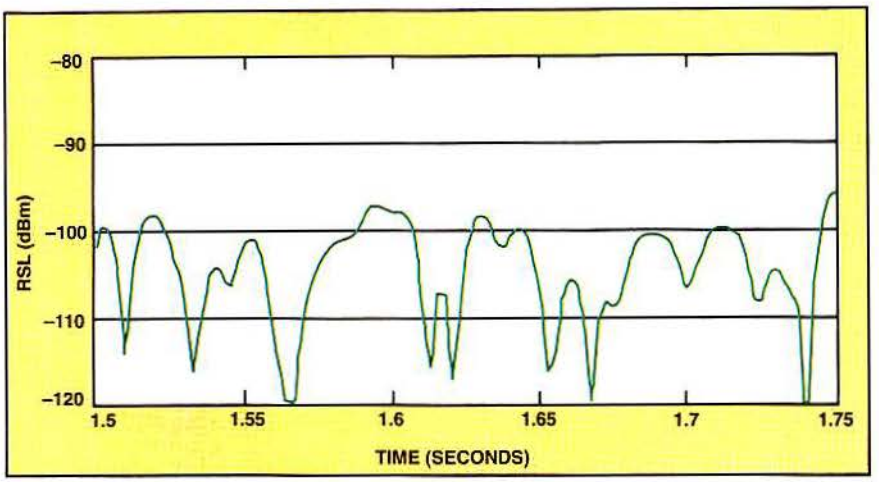
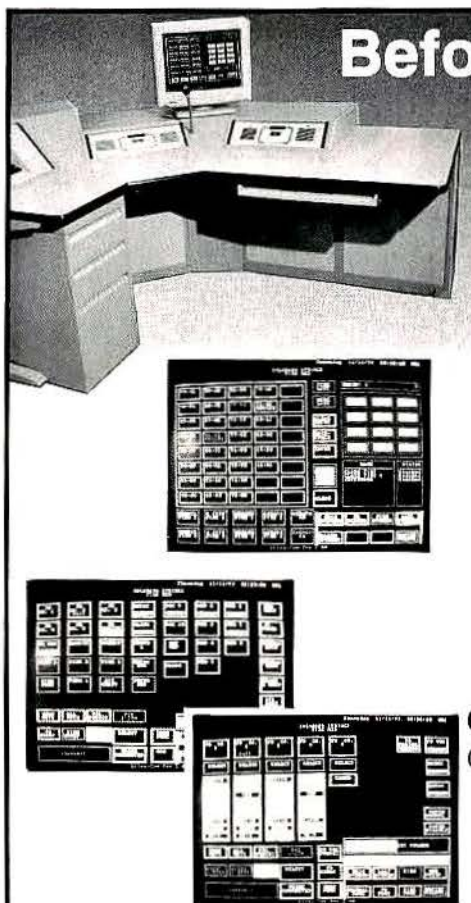


Figure 5. Plot of received signal level vs. time for a vehicle traveling 40mph. The carrier frequency is 900MHz, and the mean received level is −101dBm.



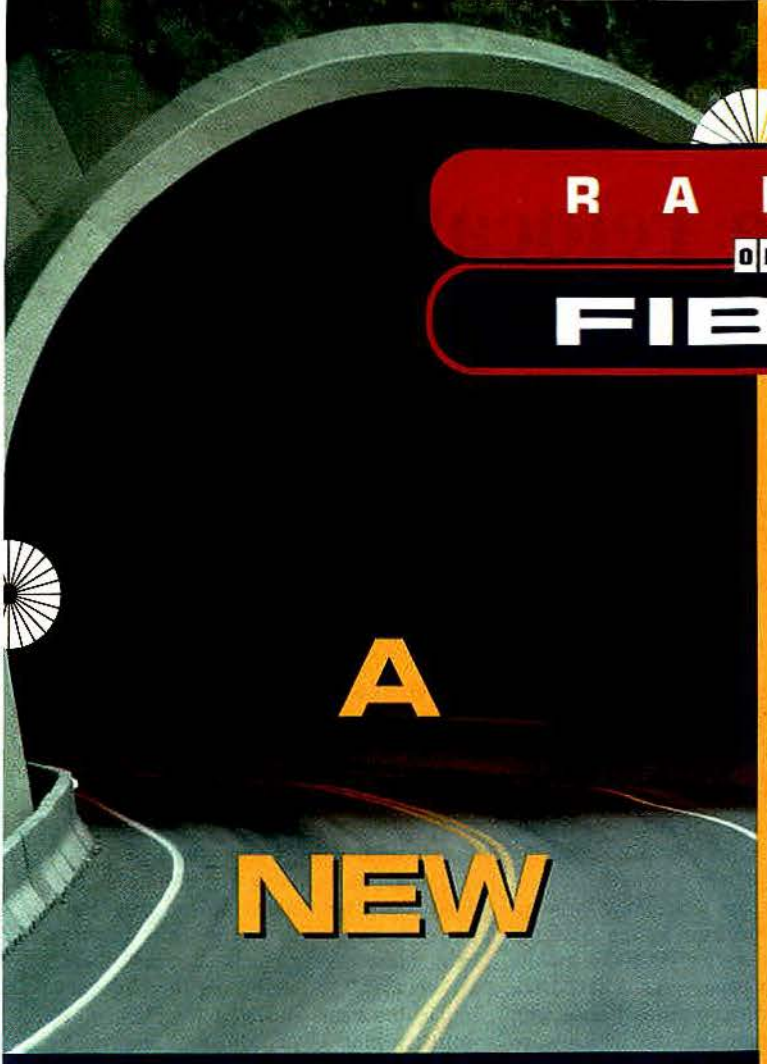
Before You Buy Any Workstation
CHECK THESE FACTS:

- ☐ **Moducom's Ultra-Com PRO** workstation permits *complete* screen programming and modifying, at no additional cost.
- ☐ **The Ultra-Com PRO** allows you to design screens for your specific requirements, without changing personality PROMS.
- ☐ **The exclusive** *SCREENMAKER* feature does not require the use of predetermined display modules or paging screens.
- ☐ **Only the Ultra-Com PRO** can completely program and reconfigure screens *without software changes.*
- ☐ **Other systems** claim "full programmability," but usually require firmware changes. Not Moducom: We claim it, *and demonstrate it!*
- ☐ **Moducom helps you** design operating screens for function, color, switch sizes and location...*and much more*, with the exclusive *SCREENMAKER* and *CUSTOMIZER* programs available only with the **Ultra-Com PRO** communications workstations..

Check the facts before you buy. Then check the source: Moducom.
Call or write for our literature package and free programming demo disk.

MODULAR COMMUNICATION SYSTEMS, INC.
13309 Saticoy St., No. Hollywood, CA 91605
(818) 764-1333 Fax: (818) 764-1992
Texas Office: 1824 Geneva Lane, Plano, TX 75075 (214) 509-8144

Circle (28) on Fast Fact Card



RADIO on FIBER™

A NEW LIGHT AT THE END OF THE TUNNEL

CHALLENGE

The Wireless Communications market continues to grow at the speed of light. As customer demands increase with subscribership, cellular and PCS operators need to go further than ever before to compete effectively, providing new, higher quality services that allow uninterrupted and expanded coverage in buildings, tunnels, canyons and congested areas.

SOLUTION

Committed to remaining a leading supplier of linear fiberoptic components for Wireless Communications, Ortel has developed a variety of high-performance *Radio on Fiber* products that allow penetration of buildings, tunnels, canyons and dense urban areas – without interruption. Cellular networks, personal communications services and mobile radio systems now have an innovative new service development tool to offer customers.

RESULTS

Ortel's remarkable *Radio on Fiber* products and equipment are now employed in cellular networks worldwide to improve coverage and increase capacity in difficult RF environments of all kinds. In whatever configuration, this cellular service enhancement technology can be tailored to meet your challenge – to keep you competitive – now and well down the line.

FIBEROPTICUPDATE

Ortel devotes considerable resources to the research and development of Wireless Communications technologies. To receive free information on these innovations, please call, write, fax or e-mail Ortel directly.

Making Light *Work* For You

ORTEL® CORPORATION

WIRELESS COMMUNICATIONS

2015 W. Chestnut Street, Alhambra, CA 91803
Phone: (818) 281-3636 Fax: (818) 281-8231
Internet: mktwl-a@ortel.com

Circle (29) on Fast Fact Card

Microwave relocation: Key to early PCS deployment

Understanding the relocation rules and establishing a negotiating strategy will lead to early deployment of personal communication services. Both incumbent microwave users and PCS licensees have incentives to act.

By Donald S. Williams, P.E.

When the FCC reallocated 220MHz of radio spectrum in the 2GHz frequency band to the emerging telecommunications technologies, it adopted a plan for sharing frequencies between the new services and the existing (incumbent) fixed microwave services.[1] Some of the incumbents have operated systems in these bands for 30 years or longer. The FCC designed a relocation plan that requires emerging technology service providers to relocate incumbent microwave licensees to "comparable" facilities when co-existence at the incumbent's current 2GHz frequency is not possible because of radio interference.[2] Such relocation must be accomplished at no cost to the incumbents. The plan provides specific periods in which to negotiate relocation contracts and offers incentives for both sides to proceed in good faith.

The following information explains the FCC's relocation plan and highlights several complex negotiating issues that may delay the startup of new telecommunications services. Understanding the problems and establishing strategies to hasten the signing of mutually advantageous microwave relocation contracts will speed the implementation of new services.

The first emerging technology to be allocated 2GHz spectrum is the personal communications service (PCS), a mobile service that now shares the 1,850MHz–1,990MHz band on a co-primary basis with the Private Operational-Fixed Microwave Service. (See Figure 1 below.) The incumbent microwave licensees are state and local governments, utilities, railroads and corporations. The FCC allocated two 30MHz blocks (60MHz total) for licensed PCS systems in each of 51 major trading areas (MTAs), and one 30MHz and three 10MHz blocks (60MHz total) for licensed PCS systems in 493 smaller trading areas (BTAs).[3] These licenses were awarded through a competitive bidding process that ended in March 1995 for Blocks A and B (the MTAs). An additional 20MHz of spectrum is allocated for use of unlicensed PCS devices.

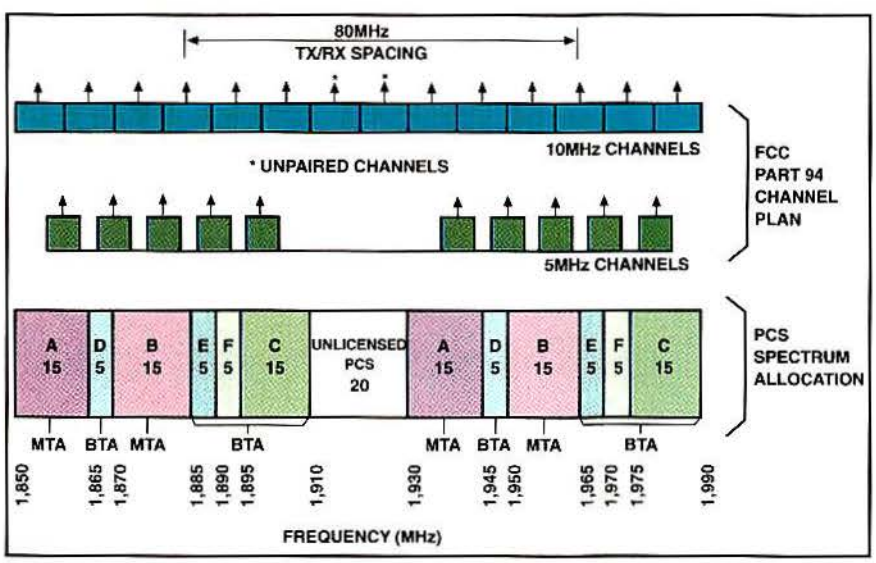


Figure 1. New PCS spectrum allocation compared to existing fixed microwave channel plan.

Initial limited PCS operations

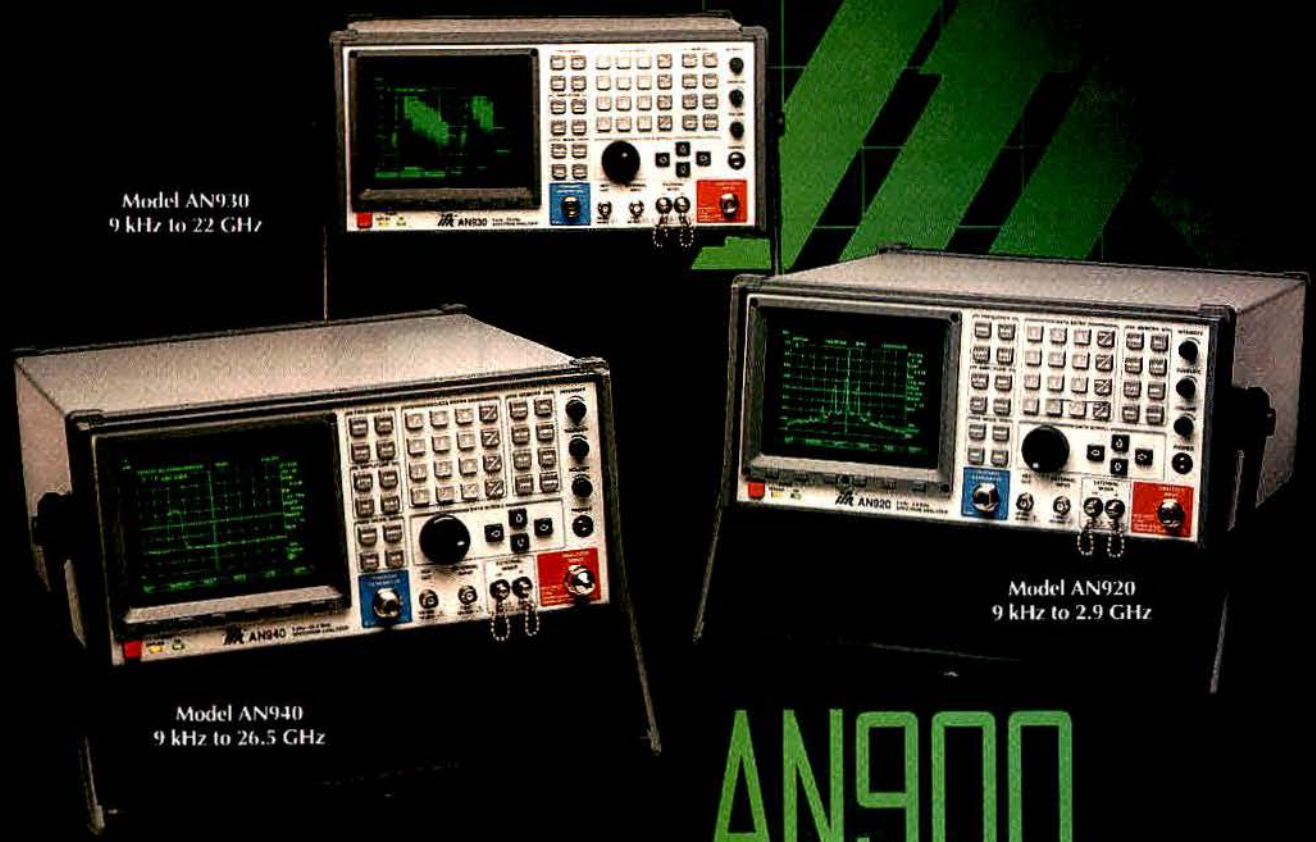
It may be possible to operate some early PCS systems at sufficiently low power to avoid interference with incumbent microwave systems. Because there are about 4,700 microwave links operating in the band allocated for PCS, it is unlikely that a "coordinated" approach will result in widespread deployment of PCS. In resolving the limitations that band-sharing places on the large-scale deployment of mobile PCS systems, the FCC concluded that it would be "in the public interest to subject all incumbent facilities, including public safety, to mandatory relocation if an emerging technology provider

[1]Emerging technologies have been allocated the frequency bands 1,850MHz–1,990MHz, 2,110MHz–2,150MHz and 2,160MHz–2,200MHz. These frequencies were previously assigned to the Domestic Public Fixed Radio Services (FCC Rules Part 21), the Public Mobile Service (FCC Part 22) and the Private Operational-Fixed Microwave Service (FCC Part 94).

[2]The comparable facilities may be at another frequency in the 2GHz band but, most likely, interference between the incumbents and the emerging technology services will require relocation to one of several higher frequency microwave bands.

[3]"MTA" means "Major Trading Area," and "BTA" means "Basic Trading Area" as defined in *Rand-McNally 1992 Commercial Atlas and Marketing Guide, 123rd Edition.*

Williams is a private consultant in Gig Harbor, WA. He has 30 years experience in microwave system design, marketing and manufacturing and has held positions with AT&T Bell Laboratories, Harris Farinon and Digital Microwave.



AN900 SERIES

REDEFINING PERFORMANCE & VALUE

THE AN900 SERIES PORTABLE SPECTRUM ANALYZERS

With frequency coverage of 9 kHz to 2.9 GHz for the AN920, 9 kHz to 22 GHz for the AN930A, and 9 kHz to 26.5 GHz for the AN940, the AN900 series of spectrum analyzers can match your RF and microwave testing requirements.

In addition to being full-featured, portable spectrum analyzers, each AN900 series model provides unique measurement features never before available on any spectrum analyzer.

A wide 30 MHz resolution bandwidth filter provides unequalled measurement capability on wideband or spread spectrum signals. When used in combination with the built-in FM/AM receiver and modulation measurement scales, direct measurement of wideband signal modulation components, including frequency agile signals, is possible.

A 25 MHz digitizing rate enables zero span measurements on pulsed RF and digital signals at sweep rates as fast as 200 ns/div. Pretrigger and posttrigger delay allow precise time interval or gated measurements.

An automatic trace limits test function performs unattended monitoring and detection of erroneous signal conditions. Captured signals can be automatically stored in memory with time and date stamp for later recall and analysis or sent directly to a plotter via the standard RS-232 or IEEE-488 interfaces.

A logical front panel control layout that avoids the use of menus or shift keys simplifies operation and enhances user productivity.

Other optional built-in features, including a 2.9 GHz tracking generator, quasi-peak detector, and 0.02 ppm time base, expand each model's possible uses.

Contact IFR for more information or to arrange for a demonstration of the AN920, AN930A or AN940.

Circle (30) on Fast Fact Card

IFR SYSTEMS, INC.

10200 West York Street / Wichita, Kansas 67215-8999 U.S.A.
Phone 316/522-4981 / 1-800-835-2352 / FAX 316/522-1360

IFRent/Lease Plan
An easy way to operate the best in test equipment
Call 1-800-835-2352

CRAFTED WITH PRIDE IN USA

requires the spectrum."[4] In making this statement, the FCC announced its commitment to accelerate the full-scale deployment of PCS and to set in motion a relocation plan that will eventually clear the 1,850MHz–1,990MHz band for use only by the new PCS providers.

Motivation to negotiate

Although incumbents may consider migrating their operations to fiber-optic links or leased satellite or terrestrial channels, systems other than microwave may not be practical. Microwave offers advantages of high transmission capacity, reliability and the flexibility to drop and insert circuits within a multi-hop system (requirements common to all microwave users), and microwave offers the benefit of system ownership and complete control by the operator-licensee.

Incumbent microwave licensees will need to overcome their tendency to object to being displaced from "their band" and to being subjected to a major relocation project that is likely to disrupt normal business operation. The FCC relocation plan mandates time limits for the negotiations, and incumbents will not be able to delay their relocation indefinitely once the spectrum has been requested for PCS use. Some incumbents may hold out and extend negotiations to get a better deal, but they should be motivated by the opportunity to replace older equipment with new and improved equipment at no cost.

Tax certificates to offset capital gains that might arise through relocation agreements are available to microwave incumbents only if a contract is signed before the end of the mandatory period. Additionally, most microwave operators have experience licensing frequencies and are aware that the 2GHz relocation requirement will create heavy demands on already crowded higher frequency bands. Most incumbents will want to apply as soon as possible for new frequencies. Finally, if an incumbent microwave licensee has refused to negotiate in good faith after a protracted period, the FCC can force an involuntary relocation and transfer responsibility for part or all of the relocation costs from the PCS provider to the microwave incumbent.

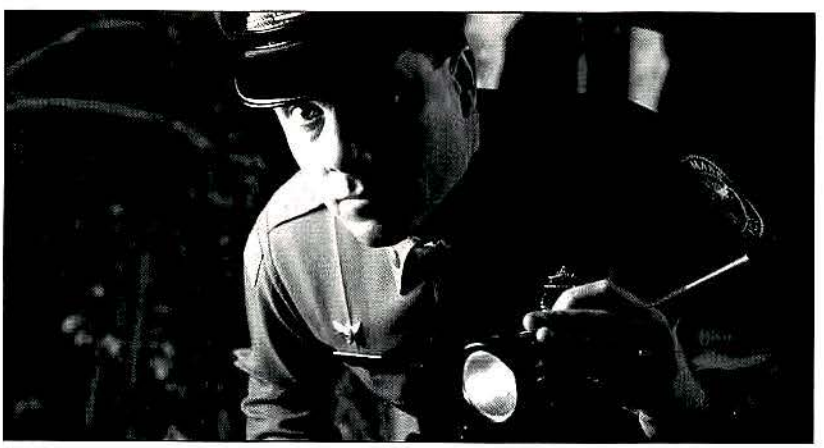
PCS providers will be motivated to accelerate relocations, perhaps offering financial incentives to incumbents on frequencies that are blocking early PCS deployment, because they may want to clear some of their spectrum and begin service. Besides the financial motivation to launch service, the FCC requires PCS licensees in the 30MHz blocks to demonstrate coverage of one-third of their market population within five years and two-thirds coverage within ten years. Licensees in the 10MHz blocks must demonstrate one-fourth coverage of their market population within five years.

Voluntary and mandatory negotiations

The FCC relocation plan stipulates a two-year voluntary period followed by a one-year mandatory period to negotiate relocation contracts between PCS providers and non-public safety microwave incumbents in the licensed PCS spectrum (Blocks A-F). Public safety microwave incumbents are allowed a three-year voluntary and two-year mandatory negotiation period (five years total). The FCC set the beginning of the voluntary negotiation period for microwave licensees now

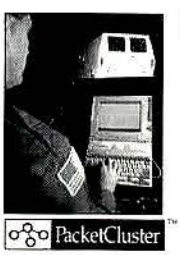
[4]*Memorandum Opinion and Order*, ET Docket No. 92-9, FCC 94-60. Adopted March 8, 1994; Released March 31, 1994.

Know Who's In That Car Before You Leave Yours



PacketCluster Patrol, the world's most powerful mobile data system, takes the guesswork out of officer safety.

Approaching an unknown vehicle can create a dangerous situation. Who's in that vehicle? With PacketCluster Patrol, you'll know by utilizing direct access to NCIC, NLETS, motor vehicle records, and your police headquarters' local database, without even leaving your patrol car.



- Access complete criminal data quickly and automatically without risking unauthorized reception.
- Prepare and transmit reports to headquarters.
- Send private messages to one user, a pre-defined group, or all users simultaneously.

A ready-to-run hardware/software solution, PacketCluster Patrol brings dispatch-quality information to officers in the field. Links to CAD, enhanced 9-1-1, and the Global Positioning System improve operational efficiency through "closest car" dispatching.

Yet, PacketCluster Patrol is so affordable you can easily provide its power to your entire force.

PacketCluster® Mobile Data Communications Patrol

PacketCluster Systems, a division of Harvard Radio, Inc.
2 Mount Royal Avenue, Marlborough, MA 01752-1935 (508) 460-4000 Fax: (508) 460-4099

Circle (31) on Fast Fact Card

NATCOM, INC./ KERN PAGER REPAIR

Quality is our Main Concern... Pleasing our Customers Just Comes Naturally





Quality Workmanship and Technology have brought us the Miracle of Communications. Quality repair and maintenance is a must to keep the lines of communication open. We offer a full line of services to keep your communications network running smoothly.

Quality, Reliability, Versatility & Affordability

NATCOM
INCORPORATED

834 Foley Street
Jackson, MS 39202
800-844-5376

KERN Pager Repair

5422 Carrier Drive, Ste. 205
Orlando, FL 32819
800-345-6067

Circle (32) on Fast Fact Card

operating in Blocks A and B as April 5, 1995. Accordingly, the voluntary period applicable for non-public safety microwave licensees in these blocks expires on April 5, 1997, and expires on April 5, 1998 for public safety microwave licensees.

Microwave incumbents are not required to relocate during the voluntary period but must agree to relocate during the mandatory period if the requesting PCS licensee meets its relocation obligations as specified by FCC rules. The mandatory negotiation period may begin any time after the voluntary period has expired, and it must be triggered by written notification to the microwave incumbent by the PCS licensee. Negotiations within the voluntary period are not an absolute requirement. Should the PCS provider decide not to contact a microwave incumbent during the voluntary negotiation period, the time available to negotiate with that incumbent decreases to only the mandatory period

Relocations involving microwave incumbents in the unlicensed device spectrum have only a one-year mandatory negotiation period beginning upon written notice to the microwave incumbent by an unlicensed device manufacturer.[5]

Now let's look at some strategies that may hasten the negotiation process.

▶ *Establish bilateral contacts early* — Microwave incumbents are required to relocate only when there is an identified demand for their 2GHz spectrum and when co-existence is not possible due to inter-system interference. Establishing the demand and initiating negotiations with affected microwave incumbents are responsibilities assigned by the FCC to licensed PCS providers or to UTAM, Inc., for all unlicensed devices.[5] PCS providers must ensure that no transmitters in their networks cause interference to incumbent microwave receivers within a coordination distance (as great as 260 miles) determined by the PCS base station's effective radiated power and antenna height before operating any of their own 2GHz transmitters. During the "prior coordination" process, the level of interferences into each incumbent microwave receiver within the coordination distance will be analyzed by the PCS licensee or by UTAM Inc.[6] Each incumbent affected by out-of-limit interference will be notified and given 30 days to make a comparable analysis and prepare a response. Most microwave systems are duplex (two-way operation), so two

Microwave incumbents are required to relocate only when there is an identified demand for their 2GHz spectrum and when co-existence is not possible due to inter-system interference.

[5]The FCC designated UTAM, Inc., a corporation funded by the unlicensed PCS industry, to plan and manage microwave relocations needed to clear the unlicensed PCS spectrum.

[6]Interference from PCS systems to fixed microwave systems is analyzed according to procedures in "TIA Telecommunications Systems Bulletin Number 10-F, Interference Criteria for Microwave Systems," June 1994 (TSB 10-F). The parties may agree to other methods of analysis.

The New STABILOCK® 4015...

The Only Radio Test Set You Can Hold With One Hand And Load With The Other

If you want a good workout, go the gym. We know how hard it is to lug around a two-way radio test set that's big, bulky and heavy. The STABILOCK 4015 on the other hand, weighs in at less than 20 lbs. and goes everywhere you have to - it even fits under an airplane or helicopter seat when you're visiting those remote locations. And, good things come in small packages.

- ☐ spectrum analyzer with audio
- ☐ electroluminescent display for easy viewing night or day
- ☐ licensed CLEAR CHANNEL LTR® testing capability
- ☐ memory cards to load & run tests automatically, including all cellular formats
- ☐ digital storage oscilloscope
- ☐ internal battery

All this plus a price that won't put you out of business. Call Wavetek today – we can put the future of two-way radio testing in your hands today: **1-800-392-8100 (in MA: 617-229-7585).**



CLEAR CHANNEL LTR is a registered trademark of the E.F. Johnson Company.
STABILOCK 4015 is a registered trademark of Wavetek.

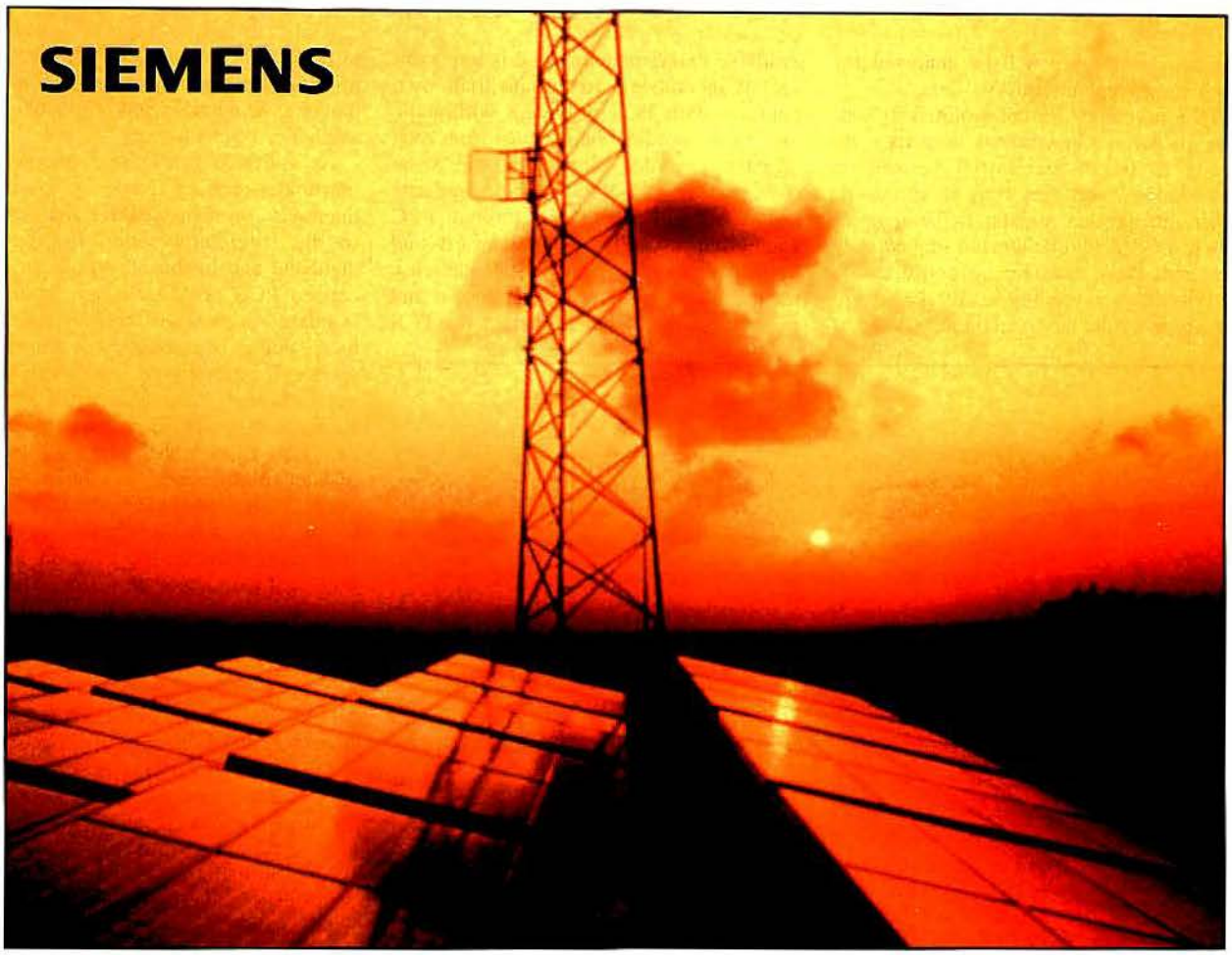
WAVETEK

Wavetek Corporation
5808 Churchman Bypass
Indianapolis, IN 46203-6109

Wavetek Corporation
128 Wheeler Road
Burlington, MA 01803

1-800-392-8100 Fax - 617-273-5943

Circle (33) on Fast Fact Card



YOUR ONE-STOP SOLAR POWER SHOP...

The need for continuous, uninterrupted electricity is essential in today's hectic business world. Hutton makes it easy to power a remote site with Siemens PowerMax™ technology. We can design a solar electric system custom fit to your application and location within your price range. We simply combine exceptional products with sensible pricing. No power? Bad Power? Intermittent power? No problem! The Power System Team can provide the solution. Usually over the phone! Simply call the nearest Hutton office. A Hutton Solar PowerPro is on-hand to answer all your questions.

SIEMENS Solar PowerPro

Wireless Power For Wireless Communications

DALLAS	ATLANTA	DENVER	SEATTLE	CANADA	JOLIET
(214) 239-0580	(770) 729-9413	(303) 820-2929	(206) 453-2132	(416) 255-6063	(815)744-6444
800-442-3811	800-741-3811	800-726-6245	800-426-2964	800-265-8685	800-435-9313
FAX 239-5264	FAX 729-9567	FAX 820-2809	FAX 453-1558	FAX 255-9179	FAX 744-8996

HUTTON

Circle (34) on Fast Fact Card

frequencies usually will be analyzed for each incumbent microwave link.

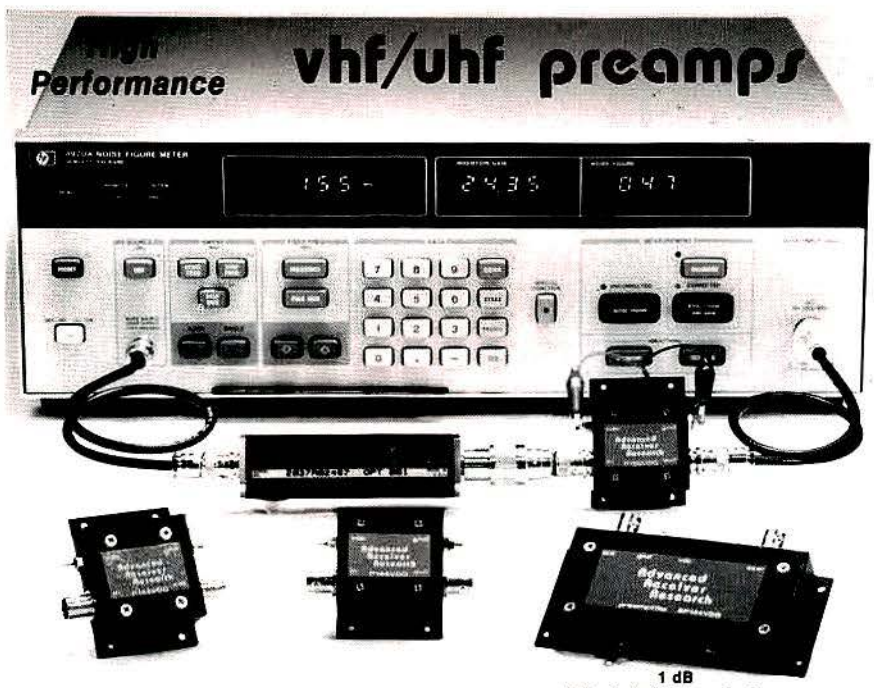
PCS providers are not required to contact microwave incumbents until they are ready to begin mandatory relocation negotiations, and then only if an out-of-limit interference exists. In rural areas where PCS networks are not immediately planned, there may be no coordination activity for many months. To take advantage of the voluntary negotiation period (if available to the incumbent), it is important for all incumbents to initiate their own contacts with PCS providers within the maximum coordination distance from each of their receivers rather than wait to be contacted by a PCS provider. Incumbents can identify PCS providers through FCC announcements of PCS license awards and knowledge of MTA and BTA boundaries. Incumbents should initiate discussions and exchange information regarding the PCS provider's proposed network layout and priority turnup schedule and should insist that the voluntary negotiation period, if available, be maintained.

As indicated in Figure 1, the standard transmitter-receiver frequency spacing for microwave systems (80MHz) corresponds to the frequency separation between highband and lowband portions of the licensed PCS provider's spectrum. This standard spacing will help to reduce the total number of contacts, but nonstandard spacings are common, and some microwave channels span adjacent PCS blocks. Because PCS providers must protect incumbents from both co-channel and out-of-band interference, incumbents should contact PCS providers licensed in the blocks shared with the incumbent's receiver frequencies and in the adjacent licensed blocks. Incumbents also should contact UTAM if the incumbent's receiver is within either of the half-blocks adjacent to the unlicensed block. Incumbents with receivers operating directly in the unlicensed blocks should contact UTAM and the Blocks A and C licensed PCS providers.

Similarly, PCS providers should contact all incumbent microwave licensees within the maximum coordination distance, including those for whom prior coordination is not immediately planned, introduce themselves, and offer to establish an ongoing planning dialog. Specific incumbents to be contacted will be known through FCC license databases. Incumbents will receive prior coordination notices from many PCS providers analyzing interference situations originating in co-channel PCS blocks and in the adjacent blocks within a given MTA-BTA and in several adjacent market areas. The incumbent microwave licensees will appreciate efforts by PCS operators within a geographical region to coordinate their contacts.

▶ *Establish characteristics of a comparable facility* — The FCC did not adopt a specific definition of what constitutes a comparable facility except that it must be "...equal to or superior to existing facilities."[7] The FCC stated that characteristics such as system reliability, speed, bandwidth, overall efficiency, frequency band and interference protection are comparability factors; but no specific guidelines or objectives were provided. Therefore, comparability is negotiable. A broad definition is that a comparable system must meet the incumbent's current and anticipated future communication needs, but items such as

[7]*Third Report and Order and Memorandum Opinion and Order*, ET Docket No. 92-9, FCC 93-351. Adopted July 15, 1993; Released August 13, 1993.



Receive only	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	1 dB Comp. (dBm)	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	−20	Bipolar	$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	−20	Bipolar	$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	$119.95
Inline (rf switched)						
SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	−20	Bipolar	$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	−20	Bipolar	$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	$139.95

Every preamplifier is precision aligned on ARR's Hewlett Packard HP8970A/HP346A state-of-the-art noise figure meter. RX only preamplifiers are for receive applications only. Inline preamplifiers are rf switched (for use with transceivers) and handle 25 watts transmitter power. Mount inline preamplifiers between transceiver and power amplifier for high power applications. System S/N improvement 6-14 dB typical. Other amateur, commercial and special preamplifiers available in the 1-1000 MHz range. Please include $2 shipping in U.S. and Canada. C.O.D. orders add $2. Air mail to foreign countries add 10%. Order your ARR RX only or inline preamplifier today and start hearing like never before!

Advanced Receiver Research

Box 1242 • Burlington, CT 06013 • 203 582-9409

Circle (35) on Fast Fact Card

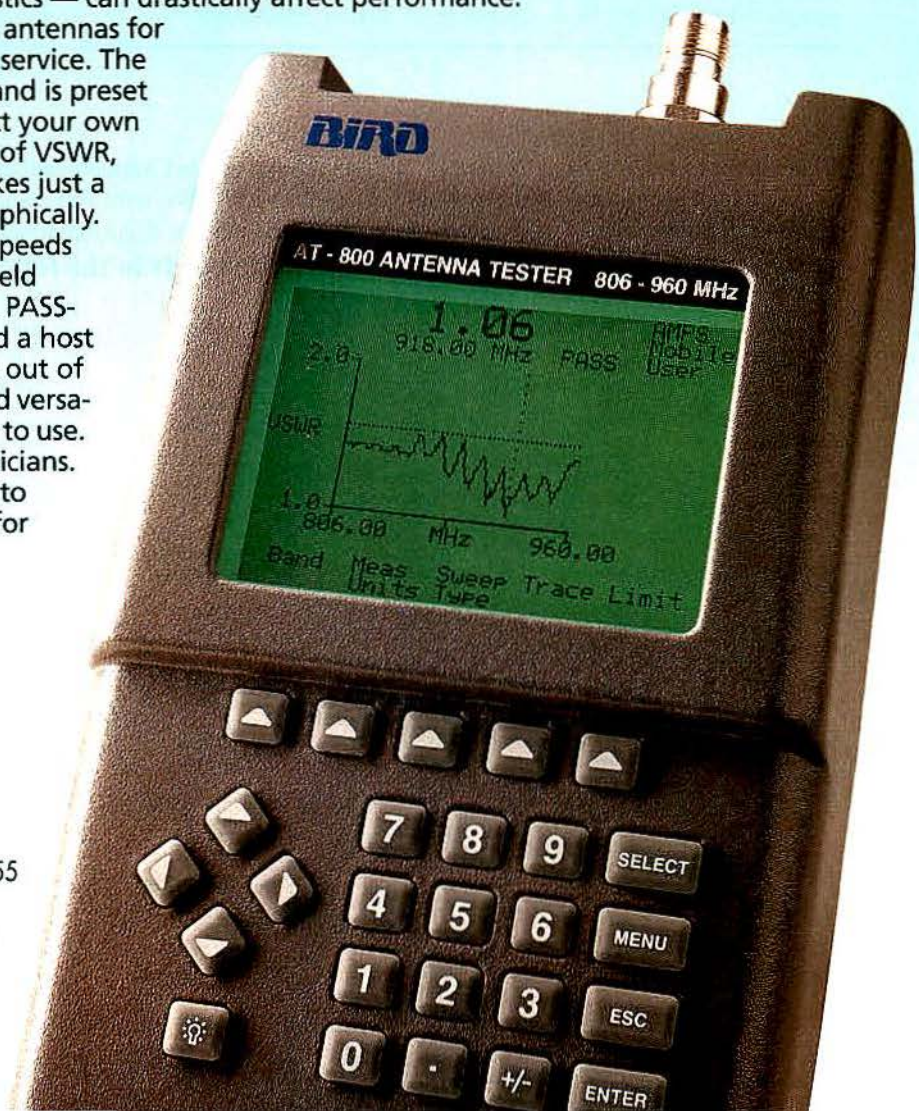
GETTING MAXIMUM PERFORMANCE FROM EVERY INSTALLATION

Bird's New Antenna Tester Eliminates The Guesswork!

Installing and troubleshooting antennas for cellular phones and mobile radios can be a guessing game. Undetected problems with connectors, cabling, antenna placement — even glass characteristics — can drastically affect performance.

Bird's new AT-800 rapidly tests antennas for any 806-960 MHz analog or digital service. The AT-800 contains its own RF source and is preset for existing cellular bands. Or, select your own frequency range. A 100-point scan of VSWR, Match Efficiency, or Return Loss takes just a second, and you see the results graphically. A simulated analog meter display speeds tuning at single frequencies, and field strength mode verifies hand-helds. PASS-FAIL testing, audible indicators, and a host of other features make quick work out of being sure. Yet, for all its power and versatility, the AT-800 is remarkably easy to use.

For installers, engineers, technicians. With the AT-800, there's no reason to guess anymore. Contact Bird now for more details.



BIRD

Electronic Corporation

U.S. Headquarters: 216-248-1200
Fax: 216-248-5426
Western U.S. Sales Office: 805-646-7255
Fax: 805-646-0275
European Sales Office: 353-61-360583
Fax: 353-61-360585
Pan-Asian Sales Office: 65-2992537
Fax: 65-2998509

Circle (36) on Fast Fact Card

improved equipment reliability, better radio fade margins to combat propagation anomalies and additional channel capacity for future growth are "extras" whose costs may be negotiated.

Although about 85% of the incumbent systems use analog microwave radios, some may want to convert to digital radio equipment. The PCS provider may not agree that such equipment constitutes a comparable facility, especially if analog radios providing the same or better service can be procured and existing analog multiplex and baseband treatment components can be reused. In this case the PCS provider may negotiate to cover only the cost of a comparable analog facility and the incumbent would assume all incremental costs of the digital upgrade.

Establishing comparability that is acceptable to all parties while minimizing overall cost will be the most difficult challenge in negotiating relocation contracts, and it may introduce substantial schedule delays. The FCC will not amend the incumbent's 2GHz operating license to secondary status until the PCS provider guarantees payment of all relocation costs, builds the replacement facility, tests it for comparability with the former 2GHz system and completes the transfer of service.[8] Additionally, if within one year after turnup the incumbent demonstrates that the new system is not comparable with the old, it can force the PCS provider to remedy all defects or pay to relocate the incumbent back to equivalent 2GHz frequencies. Clearly, the FCC expects cooperation between the parties to establish the characteristics of a comparable system. It is also clear that errors or oversights made in defining the "comparable" facility can result in essentially unlimited future costs for the PCS provider.

▶ *Consider frequency sharing or retunes at 2GHz* — Frequency-sharing arrangements should be considered, especially if it can be shown that inter-system interference can be held to an acceptably low level. FCC Rules permit, but do not require, frequency sharing at 2GHz, and then only if the incumbent agrees to accept out-of-limit interference levels. Although frequency sharing is the least costly relocation alternative, incumbent microwave licensees may not accept such a plan because future interferences that occur as PCS networks expand may prove unacceptable to the incumbent and require a later relocation.

PCS providers are free to negotiate the relocation of an incumbent's facility to another frequency in the 1,850MHz–1,990MHz band. Such a solution requires agreement among the PCS provider initiating and paying for the relocation, the incumbent microwave licensee being relocated, and the PCS provider(s) into whose spectrum the facility is being relocated. All parties must agree on the allocation of costs for a second relocation to another frequency band should an out-of-limit interference occur in the future. Such agreements are worth discussing, but it is unlikely that all parties will agree to such a solution.

▶ *Select appropriate frequency band* — Adequate frequency spectrum is available to accommodate the expected migration of 2GHz fixed microwave systems to higher frequency bands, but those making the move early will have a better choice of frequencies. In 1993, the FCC reallocated five bands above 3GHz, permitting sharing on a co-primary basis between Part 21 and Part 94 licensees, and it adopted channel plans

[8]Protection from PCS-generated interferences is no longer guaranteed once an incumbent receives secondary status at 2GHz.

Make money reselling pager & cellular airtime through Vista Communications. We are setting up satellite offices, Agents, & resellers in every state. Agents set up for less than $500. We want you on our team. We provide you with 3-day Onsite training, equipment and supplies, complete operations manual & customer accounts. Fax your request to 1-800-211-2141 or write to the address below: **We have immediate needs in the following areas:**

ALABAMA
Birmingham
Huntsville
Mobile
Montgomery

ARIZONA
Glendale
Phoenix
Scottsdale
Tempe
Tucson

ARKANSAS
Fayetteville
Hot Springs
Little Rock
Pine Bluff

CALIFORNIA
Alameda
Anaheim
Antioch
San Francisco
San Jose
Simi Valley
Ventura

COLORADO
Aspen
Boulder
Colorado Springs
Denver
Pueblo

CONNECTICUT
Hartford
Stratford

DELAWARE
Dover
Wilmington

FLORIDA
Boca Raton
Boyton Beach
Clearwater
Daytona Beach
West Palm Beach

GEORGIA
Athens
Atlanta
Cleveland
Columbus

IDAHO
Boise

ILLINOIS
Aurora
Chicago
Springfield

INDIANA
Bloomington
Columbus
Fort Wayne
Indianapolis
South Bend

IOWA
Des Moines

KANSAS
Kansas City
Wichita

KENTUCKY
Lexington

LOUISIANA
Baton Rouge
New Orleans

MAINE
Portland

MARYLAND
Baltimore
Silver Springs

MICHIGAN
Dearborn
Detroit
Flint

MINNESOTA
Minneapolis

MISSISSIPPI
Jackson

MISSOURI
Kansas City
St. Louis

NEVADA
Las Vegas

NEW JERSEY
Newwark
Trenton

NEW MEXICO
Albuquerque

NEW YORK
Albany
Buffalo
Rochester

OHIO
Columbus
Cleveland
Cincinnati
Dayton
Toledo

OREGON
Portland

PENNSYLVANIA
Pittsburgh

TENNESSEE
Brentwood
Knoxville
Nashville

TEXAS
El Paso
Ft. Worth

UTAH
Salt Lake City

VIRGINIA
Chesapeake
Hampton
Norfolk
Richmond

WASHINGTON
Mount Vernon
Seattle

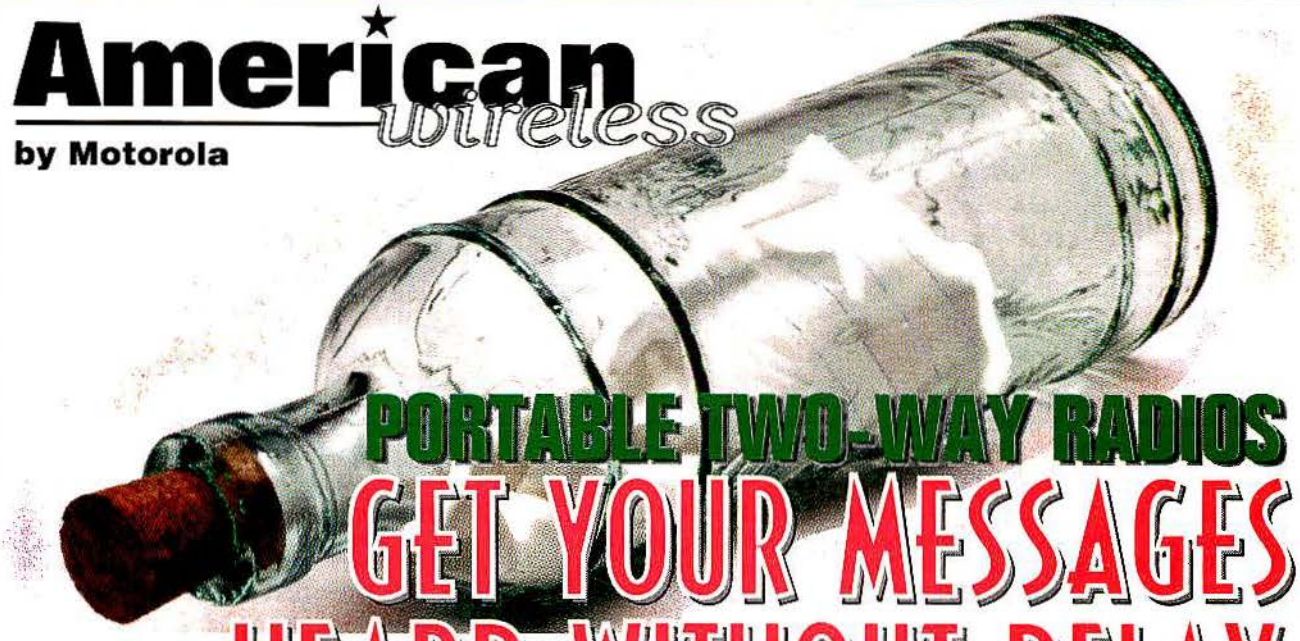
For a complete list of areas and to receive a no obligation information package write:

The Webb Group
P O Box 2032
Clarksville, Tn 37042-2032

Circle (37) on Fast Fact Card

American wireless

by Motorola



PORTABLE TWO-WAY RADIOS

GET YOUR MESSAGES HEARD WITHOUT DELAY



AV10
2-WAY RADIO

- Power Output:1 Watt
- VHF Frequency Band
- BLUE DOT (154.570 MHz)
- 4 Dealer Selectable Channels Available
- Talk Range: 1-4 Miles
- Rechargeable Battery
- 10 Hr. Charging Adapter
- Removable Belt Clip
- Manufactured in the U.S.A.



AV11
2-WAY RADIO

- Power Output:1 Watt
- VHF Frequency Band
- BLUE DOT (154.570 MHz)
- 4 Dealer Selectable Channels Available
- Talk Range: 1-4 Miles
- Rechargeable Battery
- 10 Hr. Charging Adapter
- Removable Belt Clip
- Manufactured in the U.S.A.
- Compact Size
- Audio Acc. Jack

AV11C
SAME FEATURES AS ABOVE BUT ALSO HAS:

- Coded Squelch: Eliminates Other Business Chatter on the Channel

PANA-PACIFIC
CORPORATION

PANA-PACIFIC CORPORATION OFFICES

541 Division St.
Campbell, CA 95008
(800) 726-2333

1007 Commerce Ct.
Buffalo Grove, IL 60089
(800) 726-2777

10340 S.W. Nimbus Ave. Ste. N-A
Portland, OR 97223
(800) 457-2333

8375 Camino Santa Fe Ste. D
San Diego, CA 92121
(800) 275-2333

6333 Chalet Dr.
Commerce, CA 90040
(800) 726-2689

1901 E. Carnegie Ave. Ste. 1C
Santa Ana, CA 92705
(800) 726-2234

BRIX
H. G. BRIX COMPANY

H.G. BRIX BRANCH FACILITIES

565 Display Way
Sacramento, CA 95838
(800) 359-2749

414 W. Bedford Ave. Ste. 101
Fresno, CA 93711
(800) 733-2749

Territory Restrictions May Apply.

Circle (38) on Fast Fact Card

Table 1. Range of path lengths for various radio capacities and frequency bands.

DIGITAL MICROWAVE

QUANTUM 6	QUANTUM 6	QUANTUM 10	18M	SPECTRUM 23
8 × DSX-1	28 × DSX-1	8 × DSX-1	8 × DSX-1	4 × DSX-1
192 channels	672 channels	192 channels	192 channels	96 channels
6GHz	6GHz	10GHz	18GHz	23GHz
8' antennas	8' antennas	6' antennas	6' antennas	4' antennas
22–38 miles	18–30 miles	11–23 miles	4–16 miles	2–6 miles

Notes:
Path availability ≥ 99.9995% (one-way) for 10^{-3} BER.
All systems use protected radio equipment.
Path length ranges vary with climate and terrain conditions.
Larger antennas and/or space diversity will allow longer paths.

and technical standards designed to promote efficient use of the spectrum.[*] These bands are 3.7GHz–4.2GHz, 5.9GHz–6.4GHz, 6.5GHz–6.9GHz, 10.55GHz–10.68GHz and 10.7GHz–11.7GHz. Except for the 4GHz band that was unchanged, new channel plans consisting of 400kHz to 40MHz bandwidths were overlaid on the old channel plans in a manner that allows compatibility with current users. Thus, a whole array of narrowband and wideband channels were created to accommodate the expected growth. Additional radio channels are available in several bands above 12GHz: 17.7GHz–19.7GHz, 21.2GHz–23.6GHz and 38.6GHz–40.0GHz.

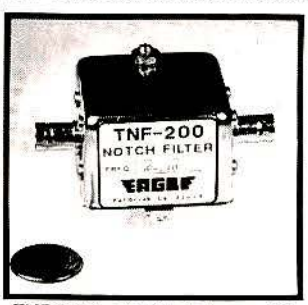
Because multipath fading tends to increase as the operating frequency increases, and above 10GHz rain attenuation begins to limit path lengths, the 6GHz bands generally will be the first choice for relocated systems. The 10GHz band will be useful for paths shorter than about 15 to 20 miles, depending on local rainfall patterns. The 18GHz and 23GHz bands will work nicely for shorter path lengths or for low-to-medium-capacity systems or both. Some extremely long 2GHz paths may require development of a new intermediate repeater; but in most cases these bands will accommodate current systems operating in the 2GHz band (the average path length is less than 20 miles), and equivalent service over the same microwave path can be achieved. See Table 1 to the left for typical capabilities of current-production microwave equipment.

Each path must be analyzed by a competent microwave system engineer to establish line-of-sight clearance, to specify antenna locations and sizes, to choose transmission line types, to calculate fade margin, and to predict propagation availability, equipment reliability and interference susceptibility. Many PCS providers, when faced with the details of designing new microwave systems, procurement specifications, frequency coordination, FCC licensing, and system installation and testing will want to acquire outside expertise to ensure that the system is cost-effective and that performance specifications in the relocation contract will be met.

▶ *Consider resource sharing* — As part

[*] *Second Report and Order*, ET Docket No. 92-9, FCC 93-350, Adopted July 15, 1993; Released August 13, 1993.

TNF-200 Tuneable Notch Filters 1.5-850 MHz

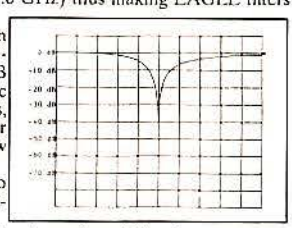


Features

- Deep notch to 35 dB
- Low VSWR
- Low loss: < 0.5 dB
- Passes to 2.4 GHz
- Up to 25 watts power
- Rugged construction
- Cost : low as 89.10

TNF-200 is a family of nine models notch filters, covering 1.5 to 850 MHz., with low insertion loss over an extremely wide bandwidth. For example the 30 MHz version passes >500 MHz or 13 times the notch frequency. This is superior to cavity filters, which also are much larger and more costly. Most of the models cover more than one octave using one easily tuned adjustment. High Q circuitry assures a deep notch and low insertion loss (less than 0.5 dB at 1.0 GHz) thus making EAGLE filters your best choice.

These filters are useful for high performance spectrum measurements by providing a 20 to 30 dB improvement of analyzer dynamic range. In harmonic measurements, for example, simply notch the carrier and remove some attenuation to view low level harmonics.



Notch filters can also be used to eliminate or identify off-band interference in communication systems.

The TNF-200 filters are in stock for immediate delivery!

But EAGLE is more than notch filters. We provide LC filters to 1.0 KW, Power Combiners, Diplexers, Triplexers and Return Loss Bridges.

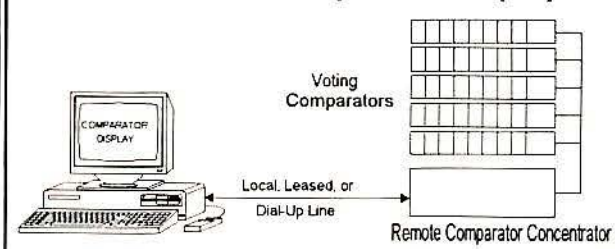
Need More Information? Call or Write Today!

EAGLE

Phone: (520) 204-2597
Fax: (520) 204-2568
PO Box 4010, Sedona, AZ 86340

Circle (39) on Fast Fact Card

Squelch your Voting System problems with a CTI Comparator Display



Features:

- Displays voting sytem and receiver status on local PCs, remote PCs, or consoles.
- Disables faulty receivers remotely — without making a trip to the comparator.
- Logs receiver failure history with time and date stamp.
- Helps diagnose system problems *fast.*
- Great for finding intermittent problems with receivers and wirelines.

Compatible with:

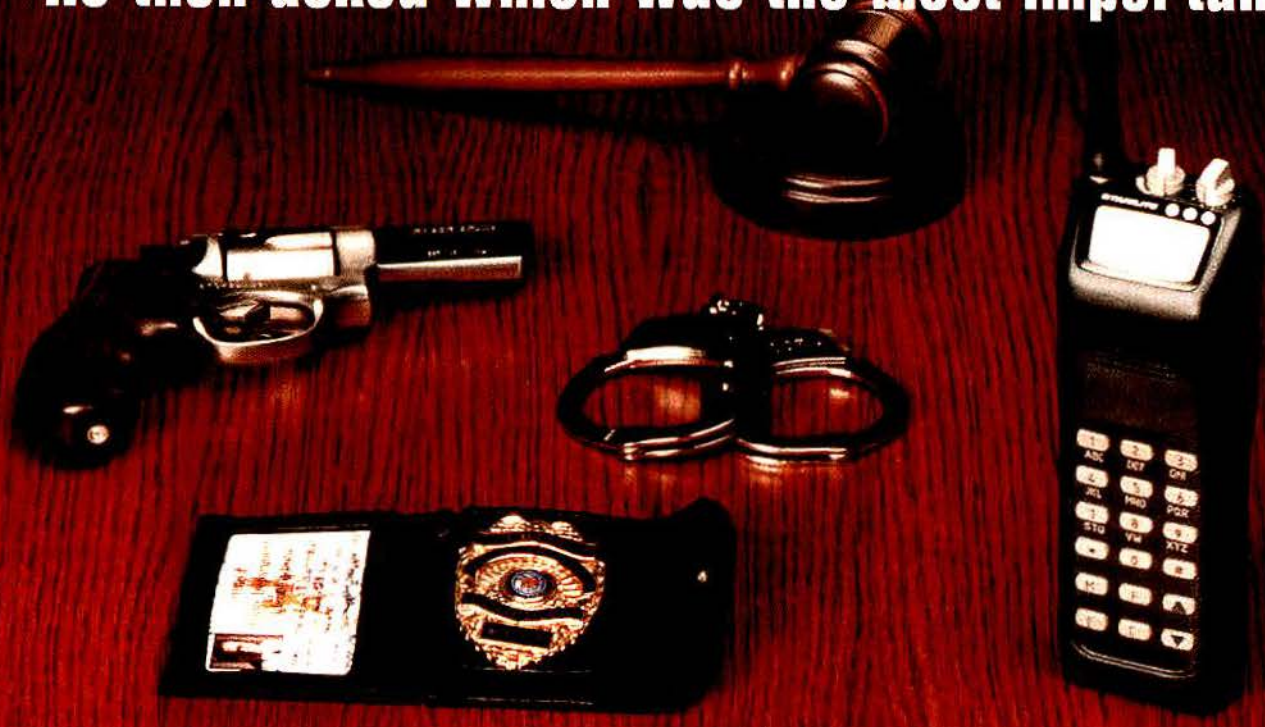
- Conventional and Trunking systems
- Motorola Digitac, Spectra-TAC, and TAC comparators
- Ericsson / G.E. Analog Voters

COMBINED TECHNOLOGIES, INC.

1211 W. Sharon Rd., Cincinnati, OH 45240
(513) 595-5900

Circle (40) on Fast Fact Card

The Chief of Police placed his gun, handcuffs, badge, and a radio in front of the City Council. He then asked which was the most important.



The old timers knew the gun was not the right answer, but we still enjoyed watching the Chief make his point. After 22 years on the force, you learn a lot of lessons... like the value of teamwork, communications, backup, and support.

"Your radio is the most often used tool you have... and it's the most important" he'd say. "On the other end of your radio is something nobody wants to mess with... and that's every other member of the police department." He made his point.

The chief is quite a character. He intimidates some, Others just look up to him. Once you get to really know him, you realize deep down, he regards each and every one of us as part of his family.

Perhaps that's why this unique presentation to the budget committee was so persuasive. It was time to upgrade our old radios to the new APCO 25 digital standard. The Chief chose Stanilite. Limited budgets were not going to keep his department from having a communications system with the best features. To this man, nothing was more important than having each of us safe every night.

Stanilite... for those who want all the features without all the costs.

STANILITE

602 House Wren Circle Palm Harbor, FL 34683 Phone 800-772-9373 Fax 813-781-7362

Circle (41) on Fast Fact Card

of relocation negotiations, PCS providers may want to explore the use of facilities owned by microwave incumbents, such as existing radio towers (to mount base station antennas), shelters, rights-of-way and spare underground conduits. Sharing existing assets may help to reduce requests to local jurisdictions for rezoning and construction permits. The microwave incumbent's own radio system and fiber-optic networks common to electric utilities may have extra capacity available for backhaul transmission between PCS base stations and central office switching equipment. Additionally, an incumbent's expertise in the areas of system installation, maintenance, operations management and legal planning might prove helpful to PCS providers. Resource sharing should be considered as a way to reduce construction and operation costs and to accelerate deployment of PCS networks. Microwave relocation negotiations provide an ideal framework in which to explore these possibilities.

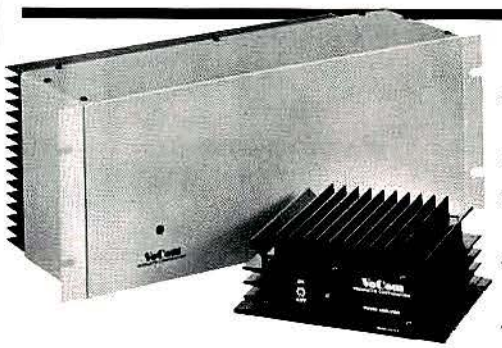
▶ *Identify cost-sharing opportunities* — PCS providers have opportunities to share the cost of microwave relocations when out-of-limit interferences into an incumbent's receiver are caused by transmitters belonging to other PCS providers. A PCS provider needing to initiate relocation negotiations to clear spectrum for its own operations may not be aware of the other interference source, or another potentially offending PCS operator may not need to clear that spectrum for operations in its own market area at the same time. Cost-sharing opportunities also exist for relocations of multihop microwave systems. Because prior coordination by all PCS operators will not occur simultaneously, cost-sharing opportunities may be missed or not identified until negotiations with an incumbent are underway or already completed.

The FCC is also granting blanket PCS licenses in each frequency block and market area and does not require individual PCS base station applications. Blanket licensing will increase the difficulty for PCS providers to pinpoint base stations in another provider's proposed system or for the incumbents to analyze interferences independently and to identify potential cost-sharing partners. Effective communication among all parties is necessary to help to identify cost-sharing opportunities that will benefit both PCS providers and the incumbent microwave licensees.

Summary

There are many technical and logistical issues to resolve, and negotiations will be lengthy, complex and potentially expensive for PCS providers as they install a new microwave system in one frequency band that shares the buildings, towers and power plants with an older parallel system. PCS providers may elect to assume full responsibility for relocations, to work with an outside firm on designated parts of the project or to contract for full turnkey support. PCS providers may need to acquire additional resources or decide what portions of the project they can handle in-house and when outside services should be employed. Most microwave equipment suppliers and several firms specializing in microwave relocation planning, frequency coordination, contract negotiation and project management have the necessary expertise. Each PCS provider should evaluate its own capabilities and seek qualified assistance when needed to negotiate effectively and implement the required microwave relocations.

BIG or SMALL
We Have It All!



POWER AMPLIFIERS
FOR ALL INPUT LEVELS

- VHF Low Band to 300 watts
- VHF High Band (140-200 MHz) to 500 watts
- UHF Low Band (400-550MHz) to 350 watts
- UHF High Band (800-960MHz) to 140 watts
- True continuous rating at high ambient temperatures
- FCC type accepted

VoCom Products Company, L.L.C.
Quality since 1979
1-800-USA-MADE
(1-800-872-6233)
FAX: 708-924-9078

Circle (42) on Fast Fact Card

The ULTIMATE PROTECTION...

NOBODY...but NOBODY beats the quality and workmanship of LEATHERSMITH's cases for two-way radio equipment.

LEATHERSMITH's specially-developed, steer hide leather cases are expertly designed by Pennsylvania craftsmen.

LEATHERSMITH's cases feature durable, rust-proof nickle-plated snaps and fasteners. Quick disconnect swivels are optional on all models in polished steel and sturdy molded nylon.

Your choice of covers is included in our low,low prices.

"Delivered on time ALL the time!"
Call TODAY for your FREE information pack
Toll-Free 1-800-233-0440 Fax 717-933-5653

Rich, full-grained leather cases for the latest models in stock now!



LOGO IMPRINTS IN CHOICE OF COLORS

The Right Choice

LEATHERSMITH

417 Frystown Rd.
Myerstown, PA 17067

Circle (43) on Fast Fact Card

How to enter the wireless world with profitability assured.



Come for free!

WirelessWorld™ Expo '95

November 7-9, 1995
Moscone Center
San Francisco, California

The fastest-growing event in wireless communications is coming to San Francisco this November. And you can be there absolutely FREE!

Explore hundreds of exhibits featuring the latest products and services available to help you gear up for the exploding wireless communications industry.

Wireless system operators, including PCS licensees, retailers, dealers, resellers, agents, large volume users, manufacturers–*anyone* whose future is affected by the new age of wireless data and voice communications–will find hundreds of profitable new ideas on the WirelessWorld Expo floor.

Also, experience the industry's most comprehensive conference.

For the most complete WirelessWorld experience, the conference program could be the smartest $495 you'll invest this year.

From the top experts in wireless, you'll find surprising solutions to the challenges you're facing today–and will face tomorrow. *Where is the cellular industry headed? What challenges do PCS licensees face? Will cellular and the new wireless carriers be able to co-exist and still make money? How much money can I make?*

This is your opportunity to find some hard answers. In a conference program that nine out of 10 participants have said they'd either attend again or recommend to others.

Return this form now for your FREE Expo Pass, plus complete information on the conference, hotels, special events and more. Or for more information, call TOLL FREE at 1-800-601-3858 or 913-967-1969.

ATTENTION VENDORS:
Prime exhibit space is filling up fast!
Contact Ms. Billi Famiglietti at E.J. Krause & Associates, 301-986-7800

ADMIT ONE

WirelessWorld Expo '95 • November 7-9
Moscone Center • San Francisco, CA

First Name _____ Last Name _____
Title _____
Company _____
Address _____ State _____ Zip _____
City _____ Fax _____
Telephone _____

PRIMARY BUSINESS (Check One)
Wireless System Operator
A ☐ Cellular
B ☐ PCS
C ☐ Paging
D ☐ SMR/ESMR
E ☐ Radio Common Carrier
F ☐ Other
G ☐ Dealer/Retailer/Sales Agent
H ☐ Manuf./Manuf Rep
I ☐ Consultant/Analyst
J ☐ End-User
K ☐ Other

YOUR TITLE (Check One)
A ☐ Owner/President/CEO/Partner
B ☐ VP/Manager/Director
C ☐ Engineer/Service Manager/Supervisor/Technician
D ☐ Purchasing Director/Manager
E ☐ Marketing/Sales Manager
F ☐ MIS/DP/LAN Manager
G ☐ Other

YOUR PURCHASING ROLE (Check One)
A ☐ Make Final Decision
B ☐ Recommend
C ☐ No Purchasing Role

FAX TO: 913-967-1900

EXHIBITS

WirelessWorld Conference & Expo is organized by Intertec Publishing Corp. and E.J. Krause & Associates

WirelessWorld™ Expo '95
Conference & Exhibition
Sponsored by:

Cellular Business · Wireless World · Telephony · Cellular & Mobile International · Mobile Radio Technology

Circle (44) on Fast Fact Card

(continued from page 10)

decibel scale is invaluable for making this kind of measurement.

Distortion test

The same setup shown in Figure 1 can be used to perform the distortion test. Simply crank up the signal generator level to about 1mV (1,000μV) and, using an accurate 1kHz modulating tone, adjust the deviation to ±3kHz to measure the distortion or SINAD reading on the SINAD meter. (Some SINAD meters have a percent distortion scale.) A typical distortion figure for a receiver is about 5% at rated audio output power.

Combining signal generators

▶ *Intermodulation test* — For certain tests, such as the intermodulation rejection test and the adjacent channel rejection test, two or more signal generators must be combined. One of the signal generators represents the desired signal, and the other(s) is/are used to produce the undesired signal.

Figure 2 on page 10 shows the setup for performing the intermodulation rejection test on a receiver. Generators A and B are used to produce the intermod signal within the receiver, and generator C represents the desired signal. The frequency of generator A is set to a frequency one channel removed from the desired (C) channel. At the same time, generator B is set to a frequency two channels removed from the desired channel with both frequencies A and B on the same side of the desired channel (C). The output levels of A and B are kept at the same level and increased until the receiver-produced intermodulation signal degrades the reception of the desired signal (C) by a specified amount.

It is important that the intermodulation be produced within the receiver and not *pre*-formed outside the receiver. The isolation amplifiers help to reduce any interaction between signal generators that might cause intermod signals to form outside the receiver. If the intermod signals are formed outside the receiver, the test result will be invalid. Figure 3 on page 54 shows the makeup of the simple resistive combiner used to couple the three signal generators to the receiver input. Hybrid combiners could be used instead of the simple resistive combiners. Hybrid combiners would offer better isolation while maintaining a proper impedance match.

▶ *Adjacent channel rejection* — Figure 4 on page 54 shows the setup for the adjacent-channel rejection test. The desired signal is produced by generator A, and generator B is set to either the upper or lower adjacent channel. Generator A is set to produce a better-than-12dB SINAD signal at the receiver output. Then, generator B is adjusted to reduce the SINAD by a given amount. The difference between the signal generator levels is the adjacent channel rejection ratio of the receiver. The resistive combiner used to couple the two signal generators to the receiver is shown in Figure 5 on page 54. Again, hybrid combiners could be used and would offer better isolation between the signal generators.

Signal substitution

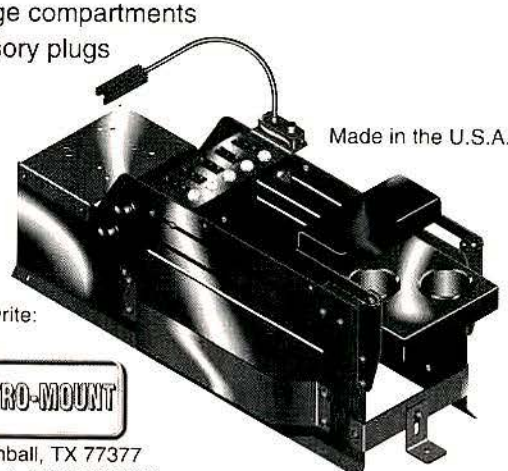
There are many times when a signal generator is a handy troubleshooting tool. For example, suppose a receiver has a dead first oscillator. When this problem occurs, no signal can be forced through the receiver at any input level. A simple check is to use a signal generator to substitute a

CONSOLES

For Real World Applications



- Airbag compatible
- MDT or laptop computer mounting platform
- Installation brackets for mobile radios & control heads
- Switch panels with fuse holders or circuit breakers
- Locking storage compartments
- 12-volt accessory plugs
- Armrests
- Cup holders
- and More



Made in the U.S.A.

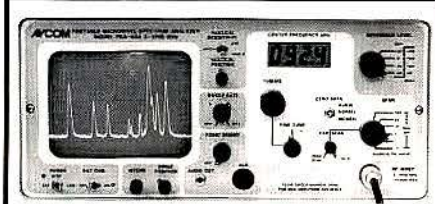
For more information on SMC Consoles & other products call or write:

SMC ELECTRO-MOUNT

P.O. Box 1607 • Tomball, TX 77377
1-800-527-1079 • Fax:1-713-356-0099

Circle (45) on Fast Fact Card

AVCOM's PSA-65A
Portable Spectrum Analyzer



The newest in the line of rugged spectrum analyzers from AVCOM offers amazing performance for only **$2855.**

AVCOM's new **PSA-65A** is the first low cost general purpose spectrum analyzer that's loaded with features. It's small, accurate, battery operated, has a wide frequency coverage - a must for every technician's bench and also great for field use.

The **PSA-65A** covers frequencies thru 1000 MHz in one sweep with a sensitivity greater than -95 dBm at narrow spans. The **PSA-65A** is ideally suited for 2-way radio, cellular, cable, LAN, surveillance, educational, production and R&D work. Options include frequency extenders to enable the **PSA-65A** to be used at SATCOM and higher frequencies, audio demod for monitoring, log periodic antennas, carrying case (AVSAC), and more.

For more information, write, FAX, or phone.

AVCOM
500 SOUTHLAKE BLVD
RICHMOND, VA
Phone 804-794-2500
FAX: 804-794-8284

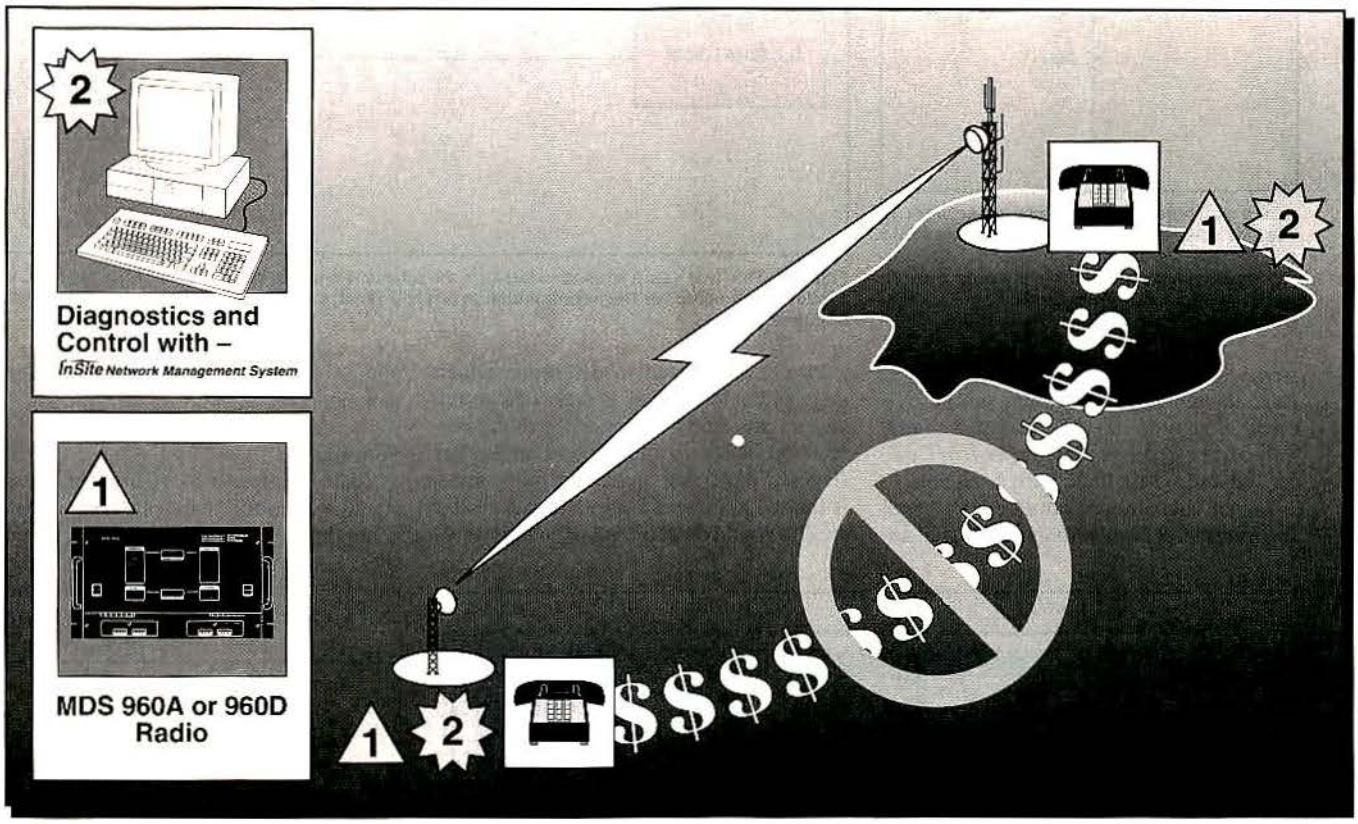
Bringing High Technology Down to Earth

Receive brochures ON-LINE via AVCOM's new AVFAX. Call from your fax and be ready to receive. 804-379-0500

Circle (46) on Fast Fact Card

CALIFORNIA MICROWAVE
MICROWAVE DATA SYSTEMS

Let MDS' Point-to-Point Radio Links — Stop Your Leased Line Cash-Flow Output



Controlling costs is important in every business. Microwave Data Systems can help by eliminating monthly leased line charges. Our affordable - reliable point-to-point radio links are used for voting receivers, base station control, paging transmitter links, trunking back haul, and many other applications.

- Available for new point-to-point frequencies of 932–935 MHz and 941–944 MHz
- Local and remote diagnostics
- Pass-through of user alarms at remote site
- Non-standby model upgrades to hot-standby model
- Analog (3, 6 or 15 channels) and digital (56–384 kbps) interfaces
- MDS digital multiplexers provide many interface options
- Choice of both synthesized or crystal frequency control
- Proven reliability
- Recognized industry leader for products and service
- Engineering Services:
 Path Analysis, Frequency Coordination,
 Licensing Assistance, and System Design

Microwave Data Systems, 175 Science Parkway, Rochester, New York 14620, USA

Sales & Customer Support	(716) 442-4000
General Business	(716) 242-9600
Facsimile	(716) 242-9620
E-mail	sales@mdsroc.com
Internet web page	http://www.mdsroc.com/

Circle (47) on Fast Fact Card

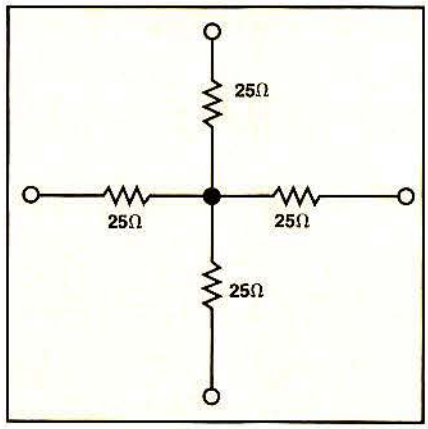


Figure 3. This resistive combiner network is used to combine three signal generators into one receiver input for the intermodulation immunity test. A hybrid combiner would provide more isolation and would be the better choice, if one is available.

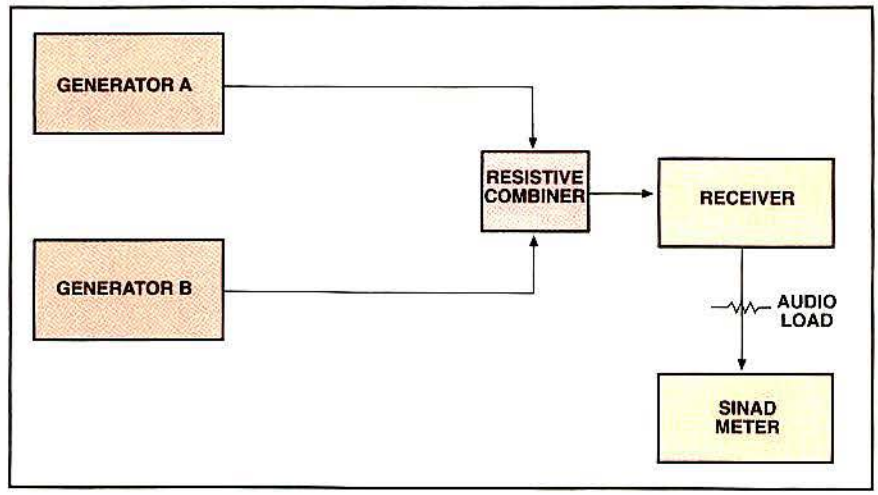


Figure 4. This test setup is used to perform the adjacent-channel rejection test on a receiver. It is similar to the setup for the intermodulation rejection test, except that only two signal generators are used.

signal for the first oscillator at the mixer. Even though this method may not be efficient, you will be able to get a signal through the receiver. The same holds true for the second or third local oscillator.

Signal substitution works equally well for transmitter troubleshooting. Signal injection can be used to determine which stage of the transmitter is dead. Make sure you set the generator frequency to the correct frequency in the case of multiplier stages! Signal substitution in transmitters is limited to the early stages because latter stages would require more signal level than is normally available from a signal generator.

Summary

There are many more uses of the RF signal generator than can be presented here. Get to know the limitations of your signal generator by studying the manual and specifications. From time to time, check the calibration: frequency, output level, modulating tone (1kHz) and deviation level. Only by keeping your RF signal generator calibrated can you get the best test results. After all, if your generator indicates 0.5μV when it is actually producing an output level of 0.2μV, you will waste a lot of time troubleshooting *insensitive* receivers!

'Til next time ... *stay tuned!*

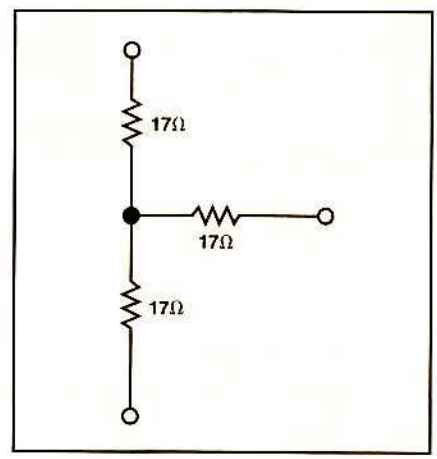


Figure 5. This is the resistive combiner used to connect two signal generators to a receiver input. Once again, a hybrid combiner would be better to use if one is available.



Syn-Tech XTR Radios

The CPI model MCR310 and MCR320 remotes allow you to remote control Midland's Syn-Tech XTR radio, up to 99 channels, over any two wire voice grade circuit.

The 310 and 320 remotes each provide you LED channel readout, channel up and down controls, speaker volume control and intercom capability between parallel remotes and the radio. Each remote also provides controls and LED indicators for PTT, monitor, P-scan, N-scan and Add/Delete functions.

Features

- Simple installation - No soldering, cutting or crimping.
- Provides remote channel indication.
- Remote transmission heard over radio speaker.
- Radio transmissions heard over remote speaker.
- Uses any two wire voice grade circuit.

CPI

1186 Commerce Drive • Richardson, TX 75801
(214) 437-5320 • (800) 869-9128 • (214) 437-5320

Circle (48) on Fast Fact Card

Mobile Radio Technology

MOBILE RADIO TECHNOLOGY
STATEMENT OF OWNERSHIP

Statement of Ownership, Management and Circulation (Act of Aug. 12, 1970; Section 3685, Title 39, United States Code).

1. Title of publication: MOBILE RADIO TECHNOLOGY

1B. Publication no. 07457626.

2. Date of filing: September 18, 1995.

3. Frequency of issue: Monthly.

3A. Number of issues published annually: 12

3B. Annual subscription price: Free to Qualified.

4. Location of known office of publication (street, city, county, state, zip code): 9800 Metcalf, Overland Park, Johnson County, Kansas, 66212-2215.

5. Location of the headquarters or general business offices of the publishers: 9800 Metcalf, Overland Park, Johnson County, Kansas, 66212-2215.

6. Names and addresses of publisher, editor and managing editor. Publisher: Mercy Contreras, Intertec Publishing Corp., 5660 Greenwood Plaza, Suite 350, Englewood, CO 80111. Editor: Don Bishop, Intertec Publishing Corp., 9800 Metcalf, Overland Park, Kansas, 66212-2215. Managing Editor: Tom Cook, Intertec Publishing Corp., 9800 Metcalf, Overland Park, Kansas 66212-2215.

7. Owner (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual must be given. If the publication is published by a nonprofit organization, its name and address must be stated.) K-III Communications, Inc., 745 5th Avenue, New York, NY 10151.

8. Known bondholders, mortgages and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages or other securities (if there are none, so state): None.

9. For completion by non-profit organization authorized to mail at special rates: Non-applicable.

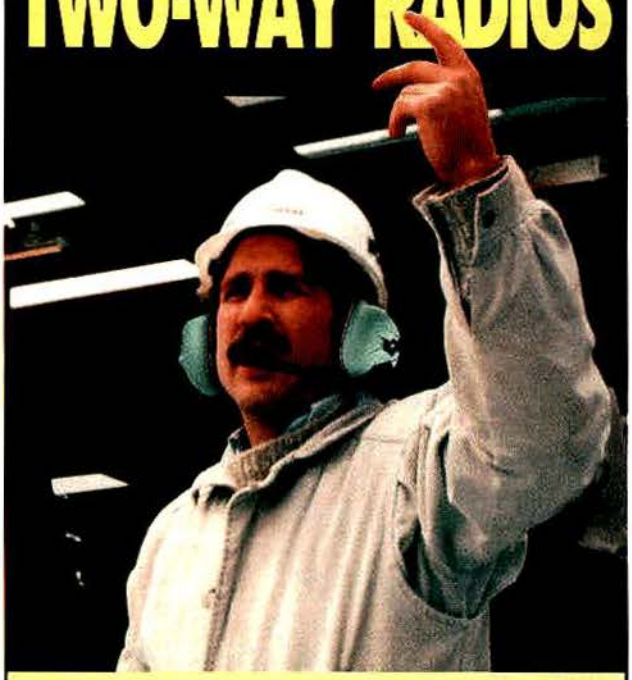
10. This item must be completed for all publications except those that do not carry advertising other than the publisher's own and are named in sections 132.231, 132.232 and 132.233, postal manual (Sections 4355a, 4354b, and 4356 of Title 39, United States Code).

	Average No. Copies Each Issue During Preceding 12 Months	Actual No. Copies of Single Issue Published Nearest to Filing Date
A. Total No. Copies Printed (Net Press Run)	27,813	27,700
B. Paid and/or Requested Circulation		
1. Sales through dealers and carriers, street vendors and counter sales	—	—
2. Mail subscriptions (Paid and/or requested)	24,517	24,608
C. Total paid and/or Requested Circulation	24,517	24,608
D. Free Distribution by mail, carrier delivery or other means (samples, complimentary and other free copies)	1,587	1,878
E. Total Distribution (Sum of C and D)	26,104	26,486
F. Copies not Distributed		
1. Office use, left over, unaccounted, spoiled after printing	1,709	1,214
2. Return from News Agents	—	—
G. Total (Sum of E and F1 and 2 should equal net press run shown in A)	27,813	27,700

I certify that the statements made by me above are correct and complete. (Signature of editor, publisher, business manager or owner.)

Michele Bartlett
Senior Circulation Manager

"HANDS-FREE" COMMUNICATION for PORTABLE TWO-WAY RADIOS



Hands-free operation of portable two-way radios is now possible with David Clark Company's Voice-Activated (VOX) Headsets. New miniaturized circuitry fits inside the headset ear cup, eliminating the need for a separate bulky VOX module.

With a Noise Reduction Rating of 24, these Voice-Activated Headsets with noise-canceling microphones, assure clear, crisp transmissions regardless of the background noise.

Choice of boom microphone headset or throat microphone headset.



No radio modification required.

For more information and a FREE DEMONSTRATION, call or write:

David Clark COMPANY INCORPORATED

360 Franklin Street, Box 15054, Worcester, MA 01615-0054
TEL: (508)751-5800; FAX: (508)753-5827; TELEX: 920482

©1991 David Clark Company Inc.

Circle (49) on Fast Fact Card

There oughta be a law

By Robert H. Schwaninger Jr.

Anyone who has read the FCC's recently released statements on operation in the 220MHz–222MHz band, aka *Second Memorandum Opinion and Order and Third (and Fourth) Notice of Proposed Rulemaking* (PR Docket No. 89-552), has to be impressed. As far as I can recall, the FCC has never proposed such unrealistic rules—rules so detrimental to existing licensees. But then, existing licensees don't bid at auction, do they?

According to the FCC's proposed rules, all of those licensees who received authorizations during the Bush Administration would be effectively precluded from modifying their locations for operation during the Clinton Administration. This is a formula for failure for those folks who constructed stations under FCC-issued special temporary authority at alternative locations. On the other hand, it is a wonderful method of ensuring channel take-backs, which is the stuff of auction inventory. In this case, it will be more of an estate sale.

How rules are made

The FCC's recent actions have my clients asking how rulemaking proceedings are started, and how proposed rules such as these beauties for 220MHz–222MHz ever find the light of day. These inquiries from incredulous consumers of the commission's cornucopia of crazyquilt rules make it necessary for this humble columnist to explain the rulemaking process.

Rulemaking proceedings originate in one of two places (three, if you count the planet Zextra). Either the FCC decides on its own to begin a proceeding (such as the 220MHz docket), or a member of the public files a request. When a member of the public files a request for a rulemaking proceeding, the request goes in THE BIG STACK. That's a 52-foot-high pile of paper that is received from regular Joes who have a terrific idea but who can not get anyone with any political pull to urge the FCC to consider it.

So how do you avoid having your great idea stuffed into THE BIG STACK? Think of a rulemaking proceeding as though it were a political campaign. Before you place your name on the ballot, you try to see whether your neighbor will vote for you. If your neighbor forgives you for the time you didn't return his hedge trimmers and supports your candidacy, you're on your way.

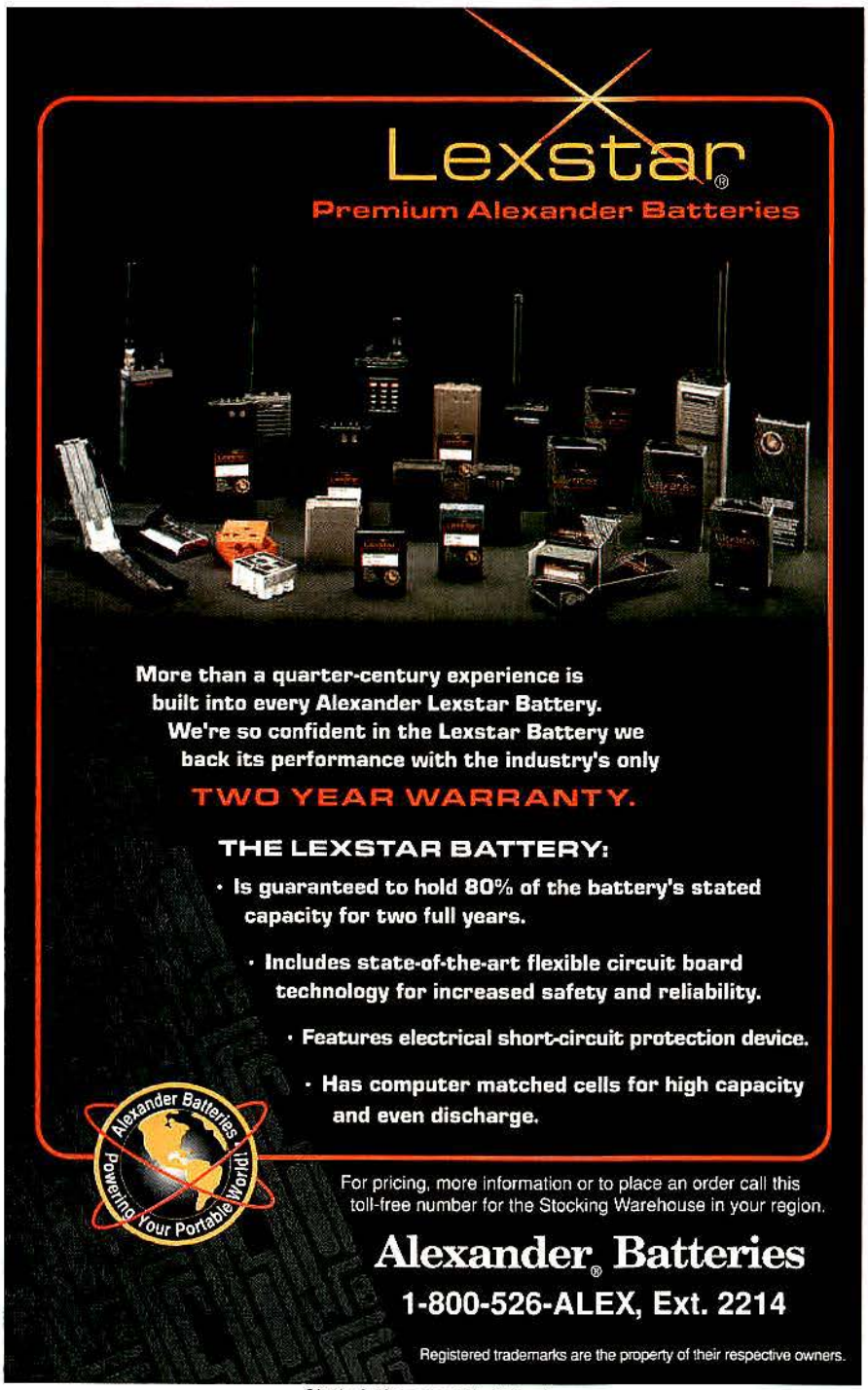
Association support

You now try your hand at the local office of the Democratic, Republican, Bull Moose, Whig, or whatever party with which you begrudgingly consider yourself affiliated. For the purpose of an FCC rulemaking proceeding, the substitutes for political parties are trade associations such as PCIA, AMTA, APCO, CTIA, or other four-letter dues grabbers.

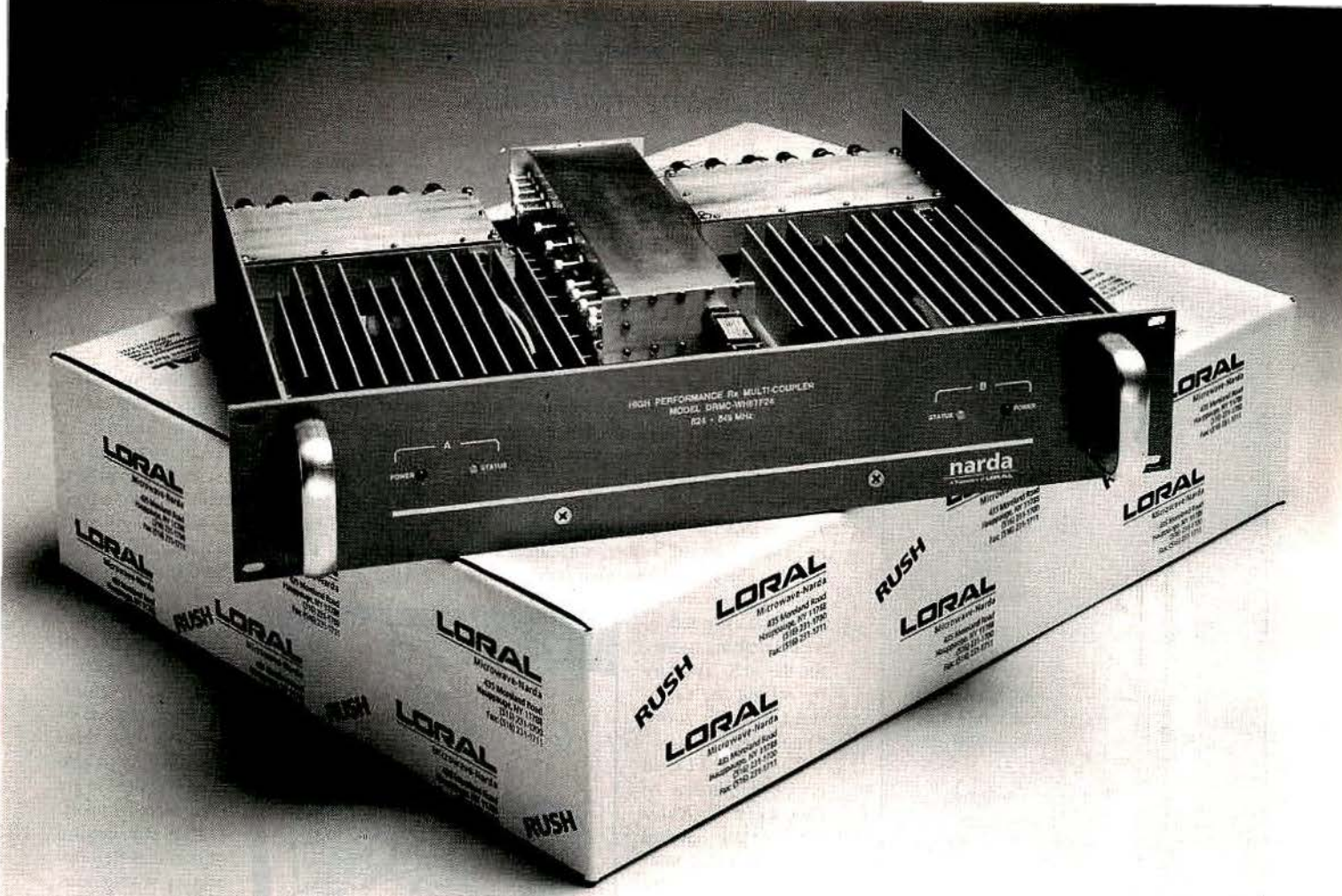
If your idea won't cause a schism in the association's membership, then you have a shot at winning sponsorship. The association even might take up the cause itself. AMTA is opposing the FCC's proposals in the 220MHz–222MHz proceeding.

Based on your deal with some association to support your efforts, you file a petition for rulemaking, with the knowledge

Schwaninger, *MRT*'s regulatory consultant, is a partner in the law firm of Brown and Schwaninger, Washington, DC. He is a member of the Radio Club of America.



Circle (50) on Fast Fact Card



New from Narda

THE NEXT GENERATION OF DUAL RECEIVER MULTICOUPLERS IS HERE.

Both standard and high performance models are now available for wireless applications.

The standard model offers exceptional specs on both performance and reliability. Maximum noise figure: 3.0 dB. IP_3 (reference to main output): 25 dBm. Nominal gain (input to main output): 22 dB $\pm$ 1 dB.

Units can be shipped from stock on a same day basis – in by noon, out by 3PM.

The high performance model is based on a new feed-forward, low noise amplifier design. This results in an exceptionally low noise figure for the complete receiver/multicoupler assembly, typically under 2.1 dB.

Other key specs for the high performance model include a gain of 35 dB or more, with high linearity (IP_3 approaches 38 dB). MTBF runs over 200,000 hours because internal power consumption is virtually nil.

Standard and high performance units are all produced in our high volume, vertically integrated manufacturing facility, assuring consistent high quality and fast availability.

For more information, call or fax Loral Microwave-Narda, 435 Moreland Road, Hauppauge, New York 11788. Tel: (516) 231-1700. International: (516) 231-1390. Fax: (516) 231-1711.

LORAL
Microwave-Narda

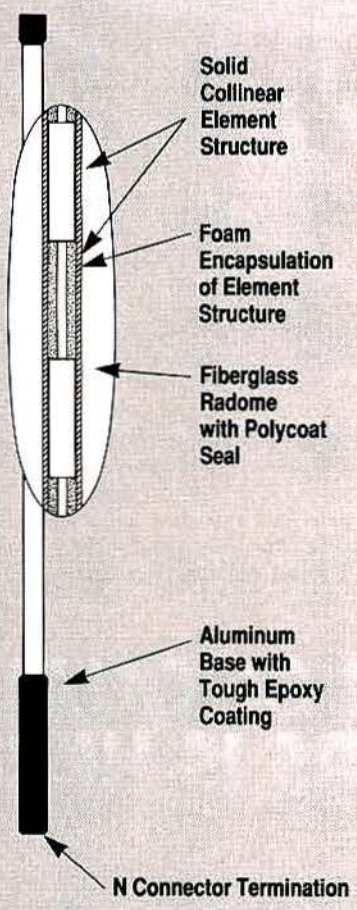
Circle (51) on Fast Fact Card

COMTELCO INDUSTRIES

Don't Be Fooled!

You don't have to pay a premium price for a premium antenna.

BSXL Series Base Antennas



Compare with the Best!

Many look alike antennas appear to be equal, but are simply constructed with a radome covering an end fed wire.

We invite you to compare our price and performance!

Call For Free Product Data Book

1-800-634-4622 Fax (708) 790-9799
Quality Products Made in the USA since 1978
Comtelco Industries, Inc.
501 Mitchell Rd., Glendale Hts., Illinois 60139

Circle (52) on Fast Fact Card

Regulating technology

that an association will support it and may even claim to represent that elusive and most-often-unconfirmed base of support, "INDUSTRY CONSENSUS." Proposals that become law are buoyed by these magical words, which suggest that the entire industry sat down over breakfast at Denny's and decided, "Yeah, that's a good idea. Go with it."

Convincing the FCC

Now the petition for rulemaking is before the FCC, which, to show that it takes the matter seriously, assigns the matter an actual docket number. That means the petition has been moved to THE BIG "IN" BOX. *That* means the petition will be dealt with in some sort of order, depending on whether the FCC thinks it's a good idea and whether Congress has created a distraction, such as raising money for the U.S. Treasury by selling the copyright to the word "Yagi."



To get the FCC to create a *Notice of Proposed Rulemaking*, you have to convince it that your idea is great for motherhood, the flag, the First Amendment, the "competitive marketplace," public safety entities, "emerging technology" and all of the winners in the PCS wideband auctions. Most importantly, the new rules should save "the scarce administrative resources of the FCC" or should enable the FCC to auction off another piece of the spectrum—preferably both.

If the FCC doesn't see the amazing benefit of your new rule, perhaps a little help from friendly congressmen would get it done. Now it's time to make the rounds at the congressional offices, explaining to each senator's bored aide why your rule would be wonderful and why the senator should support it. If these visits are done properly, your congressmen and senators will send the FCC letters of support for your idea. If the visits are done *really* well, the letter will include some veiled threat about the FCC's future budget requests.

Comment period shows FCC's hand

Okay, you've done a great job. The FCC publishes the *NPRM*. Check the comment period. If the FCC really wants to adopt your new rule, the comment period will be relatively short. The agency will be signaling to the commenters, "Go ahead and file, but this one's history." (The comment period for the 220MHz–222MHz *NPRM* was only two weeks long.) If the FCC isn't completely sold, the comment period will be longer. If you really are on thin ice, the comment period will last longer than a presidential campaign.

During the comment period, get your industry buddies, the associations, your Aunt Minnie and your dog Sparky to file comments in support. Add a few additional supportive letters from Congress, a plea from a couple of local governments and hospitals, a dash of scientific evidence (not required) and an almost-accurate economic analysis. Finally, take all of your information and make charts and graphs (using at least two of the primary colors), and go see each FCC commissioner, bureau chief, division chief and branch chief. Each ex parte contact will wear them down a little. It also buys you time to get even more support.

If a consortium of regional Bell operating companies (RBOCs) doesn't file opposing comments because your suggestion might cost them the price of a gum ball, chances are that the FCC will adopt your proposed rule before you retire—assuming that you are now under the age of consent.

Short cuts

This flippant scenario is, unfortunately, accurate. Of course, there are short cuts. For example, your rule might be highly beneficial to the FCC (meaning, they can hear the U.S. Treasury cash register ring). Or, your proposed rule might be recognized as brilliant by many large companies which quickly lend enormous support. (See, "Spectrum Giveaway for HDTV.") Otherwise, the road to law is long, tedious and expensive.

I have proposed rules. Some have made it into law. It is the duty of everyone in this industry to get involved, and stay involved, in creating the rules that will guide us all in the future. The process helps to protect free and open competition.

For all of the hassle involved, there is a feeling of immortality in being the author of a rule or law. And that feeling can't be won at lottery or bought at auction.

PCIA approves new industry standard protocol

The Personal Communications Industry Association (PCIA) announced a new standard for data transmission over existing paging and new wireless data systems. The TDP protocol suite is a set of communication protocols that provide wireless data messaging capabilities. At the recommendation of the TDP Committee, the Paging Technical Committee of PCIA has adopted this protocol suite as the standard by which formation will be entered and transmitted over the current paging infrastructure, as well as future broadband and narrowband PCS systems.

The new protocol succeeds the TAP protocol, which was designed to deliver short text messages in a one-way paging system. Using TDP, wireless carriers can implement a wide array of features, allowing users to send data files and lengthy documents and transmit the same message to multiple recipients. It can also defer message delivery and enable paging networks to store and reconcile messages. It also provides for confirmation of message receipt.

Study reveals that mobile data growth is a few years away

MTA-EMCI, Washington, DC, reports that the results of its study on the U.S. mobile data market show that the industry is gradually embracing the new service and that real growth in mobile data is unlikely until the late 1990s. EMCI statistics show that the mobile data industry has grown from 200,000 subscribers in 1990 to about 1.1 million by mid 1995. Although the annual growth rates are encouraging, the current number of mobile data users represents less than 4% of all mobile communications users. MTA-EMCI projects that the industry will solve existing problems and will serve 5.2 million subscribers and generate $1.5 billion annually by 2000.

Meridian's antenna site nears completion

The construction of Calabasas, CA-based Meridian Communications' new antenna site at Frazier Mountain is almost complete, and the company expects the facility to be ready for occupancy by mid-autumn. The site will have a block building of about 2,000 square feet, a self-supporting 124-foot tower and a large standby power generator. It is in Ventura County near Gorman and will connect the San Joaquin Valley with the Los Angeles basin.

Critical Data, Ericsson join to expand mobile data presence

Critical Data Systems, Longwood, FL, and Ericsson Private Radio Systems, Lynchburg, VA, have joined to promote the widespread acceptance of mobile data applications. The initial project combines Critical Data Systems' flexible mobile data software package, 4DAT, with Ericsson's network platform, EDACS. The partnership is an attempt to expand the field of target customers for mobile data and match them with applications that can be adjusted to suit various users' needs. Public safety applications include license plate queries and remote filing of incidents and reports, and 4DAT can be adjusted to accommodate such users as tow truck fleets and housing code inspectors.



Circle (53) on Fast Fact Card

Product/Logo directory

For more information on the products and services offered by the following advertisers in this issue, circle the corresponding number on the Fast Fact Card found on page 89.

Allen Telecom Group
Allen Telecom Group produces base station equipment, including amplifiers, antenna systems, duplexers and multiplexers; signal coverage expanders, including boosters, microcell systems and repeaters; wireless measurement instruments; land mobile and cellular antennas; and systems integration.
Circle (301) on Fast Fact Card

Alexander Batteries
The Optimizer 2000 Series battery maintenance system will discharge and condition NiCd, NiMH, SLA and L-Ion batteries. It features a large LCD and fully interchangeable battery adapters. Battery diagnostics can be compiled on a computer through an RS-232 serial port using a Microsoft Windows software package available from Alexander Batteries.
Circle (302) on Fast Fact Card

Andrew Corporation
Andrew Corporation is an international supplier of communications equipment and services. Andrew offers base station and microwave antennas, as well as coaxial cable, connectors and accessories for wireless communications applications.
Circle (303) on Fast Fact Card

Cellular Wholesalers Inc.
CWI, a distribution powerhouse, delivers the best in cellular phones, accessories, pagers, two-way radios and cordless phones including Bel Tronics, Motorola, NEC, Nokia, OKI and Toshiba.
Circle (304) on Fast Fact Card

Combined Technologies
Combined Technologies manufactures remote display and control equipment for receiver voting systems. It also makes transmitter steering controllers that work with comparators (voters) to steer multiple transmitters.
Circle (305) on Fast Fact Card

Comtelco Industries
Antennas and related installation products for commercial two-way and cellular applications. Mobile antennas, yagis and omnidirectional base station antennas covering from 25MHz to 3GHz.
Circle (306) on Fast Fact Card

DataCom
Manufacturers of exceptional wireless voice and data products. Excellent for voice and computer communications. Will support V.34 modems, totally transparent to the end user. Can be used across state lines.
Circle (307) on Fast Fact Card

DuraComm
Two-channel programmable tone and voice pagers in VHF, UHF and lowband. Switchmode power supplies from 7A to 75A. Including 12Vdc, 24Vdc, 110Vac/220Vac switchable. Modular power systems.
Circle (308) on Fast Fact Card

Gamber-Johnson
Gamber-Johnson has improved the base used to mount MissionControl products. The new version features a three-piece design to allow easier installation and the ability to upgrade to fit new or different vehicles. Bases are available for a variety of makes and models.
Circle (309) on Fast Fact Card

IDA
IDA Corporation is the world leader in the design and manufacture of tone and dc remote controllers. The new Super 99 series allows control and display of as many as 99 channels as well as complete control of many popular trunking radios.
Circle (310) on Fast Fact Card

IFR Systems
IFR Systems designs, manufactures and markets communications service monitors, RF and microwave spectrum analyzers and avionics test equipment. The company also provides test equipment for fiber-optic systems.
Circle (311) on Fast Fact Card

Midland Systems
Midland is a full-service systems integrator: providing, designing and installing custom wireless systems solutions. It also manufactures a complete line of FM two-way communications equipment: trunked, conventional and SMR.
Circle (312) on Fast Fact Card

Shure Brothers
The system approach to land mobile. Shure's ModuLink System 1 offers five quality microphones with modular cordsets that quickly connect to most radio transceivers with no hardwiring.
Circle (313) on Fast Fact Card

Transcrypt International
The DME 9600 dual-mode encryptor provides both digital encrpytion and analog voice privacy over the public switched telephone network (PSTN). The unit is backward-compatible with Transcrypt's analog cellular and landline voice privacy products. THE DME 9600 plugs between the handset and base unit of any office phone, preserving proprietary features and functions.
Circle (314) on Fast Fact Card

VoCom Products
VoCom Products designs and manufactures RF power amplifiers. It offers linear A and AB amplifiers for the PCS and cellular markets, and class C amplifiers for the trunking, paging and two-way radio markets.
Circle (315) on Fast Fact Card

Wavetek
The 4032 Stabilock supports all of the known digital cellular formats. It will test TDMA, GSM, JDC at 800MHz and 1.5GHz mobiles and base, CDMA mobiles and base and CS-1800 at 1.8GHz.
Circle (316) on Fast Fact Card

Refer to the Advertisers Index on page 88 for the page reference to the company's advertisement

VOICE REPORTING



SentriVoice+

- Monitor alarms & alert over radio
- NEMA 4X case with battery backup
- Respond via DTMF remote control
- 80 seconds of voice storage
- Integrate with Security/Fire Systems
- Automatically send pages
- Motorola 2-tone paging
- 8 inputs
- On-site paging
- Any radio mounts inside case

Replaces Motorola's Voice Reporter VR 100

ZETRON®

Cost-effective solutions by a leading supplier of Radio Communications Systems.

Zetron, Inc., Industrial Systems Division
12335 134th Ct. N.E., Redmond WA 98052 Ph: (206) 820-6363 Fax: (206) 820-7031

Circle (54) on Fast Fact Card

Readers' choice

Of all the new products and services in the April 1995 issue, the one reprinted here generated the most reader requests for additional information. If you missed it the first time, here is your opportunity to acquire more information on it. Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

GPS tracking module supports external devices, status sensors

The second-generation V-Track GPS-based tracking module from Radio Satellite Integrators is designed for vehicle, vessel and object tracking. New features include a more rugged design to military specifications, improved power conditioning circuitry and higher temperature range capabilities for hostile mobile environments. Additional data and accessory ports support external devices such as MDTs, emergency buttons and vehicle status sensors. A 10-channel, all-in-view GPS receiver provides instantaneous satellite switching to eliminate losing the signal lock on a moving vehicle.

Circle (500) on Fast Fact Card

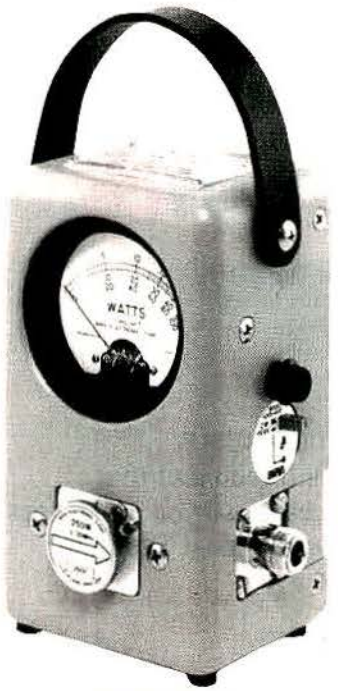
Software processes, tracks and manages return materials authorizations

Serialized Inventory (SI) is the latest addition to the ServicePlus Series 2. SI addresses the critical business issues of processing, tracking and managing return materials authorizations (RMAs) and the associated cross shipping programs being offered by manufacturers. SI is the eighth module in **ServiceWare's** ServicePlus Series 2, an integrated service information system that automates and manages all aspects of the service function. Version 2.30, a new release that includes work order costing, as well as 37 enhancements, is also available.

Circle (401) on Fast Fact Card

BIRD

WATTMETERS, ELEMENTS, ATTENUATORS & LOADS



◆ In Stock
◆ Best Prices
◆ Quick Service

We earned our position as the leading Bird distributor with a big inventory, good prices and quick service. We would like to earn your business . . . call today.

TOLL-FREE (800) 877-7979

HENRY RADIO

2050 South Bundy Drive
Los Angeles, CA 90025

Phone (310) 820-1234
FAX 310-826-7790

Circle (55) on Fast Fact Card

We've Got Your Power Mains Protected!



- Fast <25ns – Full Leads
- Breakered Internally
- Local and Remote Status
- Independent of User Loads
- Surges Shunted to Entrance Ground
- *NRTL 1449 Approved
- 10-Year Warranty

2500 models of coax, power and twisted pair protectors ... plus lightning/EMP and grounding solutions

PolyPhaser CORPORATION

(800) 325-7170 • (702) 782-2511
FAX: (702) 782-4476
2225 Park Place • P.O. Box 9000
Minden, NV 89423-9000

Circle (56) on Fast Fact Card

Make The Right Choice!

CWI
CELLULAR WHOLESALERS, INC.

PAGERS
SYNTHESIZED • IMMEDIATE DELIVERY

CALL FOR DETAILS! Panasonic
VANGUARD EX
As low as $77.00
VHF, UHF, 800Mhz
Fully programmable

NEC
SPORT II
$65.00
VHF, 900Mhz
Various colors

uniden
PGN SERIES
CRYSTALIZED PAGERS
as low as $65.00 VHF, UHF available

MOTOROLA
FULL LINE OF PAGERS AND ACCESSORIES AVAILABLE — INCLUDING PROGRAMMING SOFTWARE!

PAGER CHAINS
$1.50
only
Virtually Unbreakable!

LOW PRICES!
Crystalized pagers available on special order!

800-395-0505
5151 WEST CHURCH STREET
SKOKIE, IL 60077
708-965-2300
FAX 708-676-8960

— NEW LOCATION IN MIAMI —
305-592-1100
3100 N.W. 72ND AVE., UNIT 102
MIAMI, FL 33122
FAX 305-592-4949

Circle (57) on Fast Fact Card

New products

Disguised antennas feature rugged stainless-steel masts



The VHF XXX-SB-150 series and the XXX-SB-450 series from **Sti-Co** are additions to its roster of disguised fender-mount broadband antennas. The antennas feature rugged stainless-steel masts. The XXX-SB-150 series has 24MHz bandwidth (150MHz–174MHz), and the XXX-SB-450 series has 67MHz bandwidth (403MHz–470MHz.) The AM/FM antenna replacements are customized for all Chrysler, Ford and GM body styles and also many Euro-Asian models. The antennas also feature built-in ultra-high efficiency AM/FM broadcast couplers.

Circle (402) on Fast Fact Card

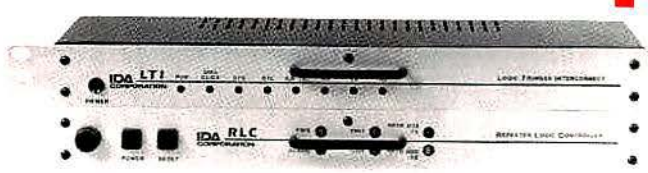
Mobile signal analysis system incorporates laptop computer



The STI-900 mobile signal analysis system fully automates the drive test procedure of making measurements, analyzing data and producing meaningful color reports to demonstrate results. The system from **Survey Technologies** incorporates a laptop with as many as four PCMCIA slots, touchscreen color interface, data acquisition and analysis software and multi-channel GPS. The unit automatically acquires signal strength measurements during drive tests. Once data have been acquired, a color contour plot can be produced on screen or printed in seconds.

Circle (403) on Fast Fact Card

AT IDA WE DON'T PUT THE SAME PRICE ON PERFORMANCE AS THE OTHER GUYS.



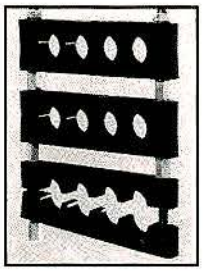
450/800/900/220 MHZ COMPATIBLE.
Advanced SMR Trunking Logic and Interconnect that improves your return on investment because you invest less to begin with. That's why IDA makes the most SENSE.

IDA CORPORATION
1345 West Main Ave., Fargo, ND 58103

Call us today:
1(800)627-4432
1(701)280-1122
FAX 1(218)233-1886

Circle (58) on Fast Fact Card

Cable hangers support multiple runs of coaxial cable



Heliax Hanger Blox cable hangers from **Andrew** are stackable, two-piece, polycarbonate blocks designed to support multiple runs of cable on communications or water towers, walls and rooftops. Additional cable runs may be installed by bolting another block to the previously installed block. Installation requires only two standard wrenches to attach the hanger to the tower member or cable ladder. The hangers are UV-stable and weather resistant and are available in four sizes to accommodate ½", ⅞", 1¼" and 1⅝" coaxial cable.

Circle (404) on Fast Fact Card

Hand-held transceiver includes 5W RF output on 10 channels



The MicroTalk hand-held two-way radio includes 5W RF output on 10 synthesized channels with multiple CTCSS tones and user-selectable scan to lock out or avoid busy channels. The back light for the LCD turns off automatically to reduce power consumption. Available in VHF and UHF models, the transceiver comes with a belt clip, a 600mAh battery, a 110V wall charger, a rubber duck antenna and a wrist wrap. **Global Wireless Communications Products** supplies the transceiver to end-users, and **Advanced Viedotech** supplies the transceiver to dealers.

End users circle (405) on Fast Fact Card
Dealers circle (406) on Fast Fact Card

Telecommunications facility database available on CD-ROM

Communications Data Services now offers the **Fryer's Site Guide** database on a variety of digital media, including 4mm or 8mm tape, floppy diskettes, ½" 9-track magnetic tape and CD-ROM. Fryer's Site Guide is a comprehensive listing of telecommunications facilities in the United States, including Alaska and Hawaii. The database has been compiled and published as a series of books divided into six regional summaries. Customer demand has made it feasible to issue this database in a digital format. The database provides latitude and longitude coordinates, height AGL or AMSL, city name for the location and contact information for the owners and managers. CDs can sort the data by BTA or MTA for the entire United States and can sort based on different site criteria for most effective presentation.

Circle (407) on Fast Fact Card

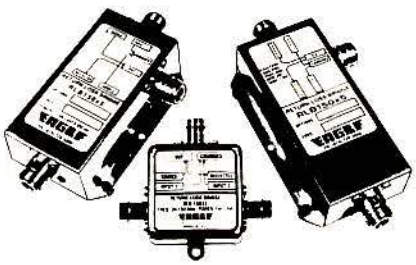
Paging entry unit sends as many as 240 characters; offers call progress



The AlphaMate 250 paging entry unit offers call progress, which improves status monitoring and makes status display optional rather than automatic. The unit from **Motorola** has a fast batching mode that lets the user send a batch of as many as 20 pages to a common paging operator. Local directories can store as many as 250 pager numbers and as many as 16 service providers, so the user can enter either personal names or pager numbers. The unit automatically keys the name to the correct service provider and pager number. Messages can be as long as 240 keystrokes. The unit's keyboard offers a standard, full-ASCII character set with upper case lock, separate function keys and type-ahead buffer. The LCD shows two lines of 40 characters and has contrast controls.

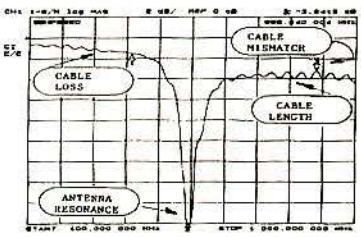
Circle (408) on Fast Fact Card

EASY ANTENNA & TRANSMISSION LINE MEASUREMENTS



Tired of not knowing where your antenna stands? Wattmeters that test one frequency or antenna testors that are disturbed by outside signals letting you down? Most of the answer is on your bench. Adding an EAGLE return loss bridge to your service monitor makes a complete antenna measurement system.

Return loss bridges from Eagle cover from .04 MHz to 3.0 GHz. These are self contained units that require no attenuators, amplifiers or detectors. All the additional equipment is contained in your service monitor or spectrum analyzer. Five watt power rating, unmatched in the industry, protects YOUR bridge from power coming from the antenna at crowded sites. Rugged nickel plated brass enclosures assure excellent durability



Free: Application note, "Antenna and Feedline measurement", call and ask for it! The following EAGLE products will also aid in testing: Precision coaxial cable jumpers, power splitters, and reference terminations. Eagle RLB150 series bridges start at $259.00.

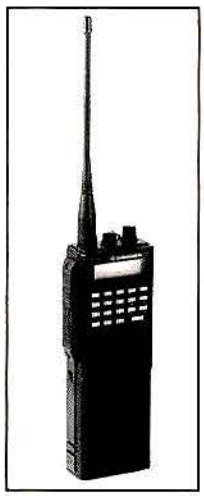
EAGLE

VOICE: (520) 204-2597
FAX: (520) 204-2568
P.O. Box 4010 Sedona, AZ, 86340

Circle (59) on Fast Fact Card

New products

Portable offers selection of as many as 10 systems



The Monogram LTR Compatible portable radio from **Ericsson** is housed in a die-cast aluminum cabinet for duability and performance. The radio offers selections of as many as 10 systems, with as many as 10 groups per system. The unit is operational in both conventional and trunked modes, each with the Talk Around feature. Users may scan any of five scan modes, including system scan with lockout and first available system scan. A phone mode button provides send and redial features with storage capacity of as many as eight telephone numbers.

Circle (409) on Fast Fact Card

Prism Network Router (PNR) acts as TNPP 'firewall'

The Prism Network Router from **TGA Systems** acts as a TNPP "firewall" protecting the paging terminal from receiving unwanted paging traffic from others on a common TNPP network. Each source code is individually provided with system level permissions. These permissions allow the receiving terminal operator to select service requests that it will accept from other carriers on the TNPP network. The PNR firewall prevents unwanted command packets from being received by the paging terminal, protecting the integrity of the terminal operation against outside interference. TNPP routing steers paging traffic to the proper physical port based on the destination code. This provides a "hub" function for proper deliver of TNPP traffic to various channels.

Circle (410) on Fast Fact Card

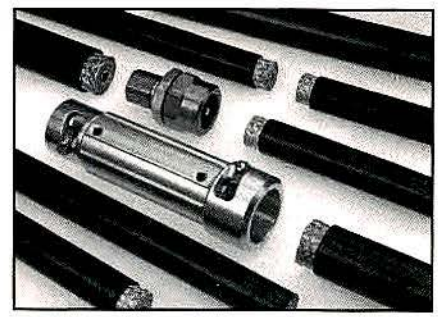
Measurement tool can be configured with eight receivers



The Octas portable multichannel mobile radio test and measurement system from **Berkeley Varitronics** is designed for drive testing and coverage measurements. The system can be configured with as many as eight receivers for monitoring, measuring and recording data simultaneously. Navigational information is supplied by internal GPS and LORAN receivers and odometer input. Data records are stored internally and on a removable battery-packed 2MB PCMCIA card. An RS-232 input is available for downloading data to a PC. Octas is available in three frequency bands: 935MHz–941MHz, 851MHz–870MHz and 405MHz–512MHz. An onboard program is included for precise autocalibration with proprietary Marconi software. Included with each instrument is a remote display that allows the user to control and monitor the system functions from a dashboard-mounted remote control.

Circle (411) on Fast Fact Card

Cable prep tool prepares both LMR-900 and LMR-1200



Time Microwave Systems offers a cable prep tool that preps both the LMR-900 (⅝") and the LMR-1200 (⅞") cables for connector attachment. On each end of the tool is a stripping head that removes the cable jacket to the correct dimension for connector attachment by rotating the tool with respect to the cable. One end strips the LMR900; the other strips the LMR-1200.

Circle (412) on Fast Fact Card

Converter boasts compact size; runs cool for dashboard mounting

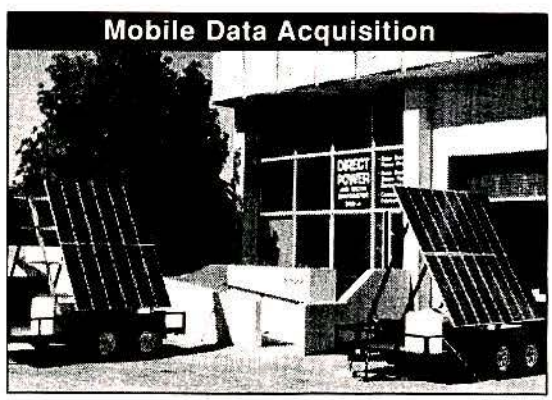
The VC6G voltage dropper is a fixed-frequency linear 24Vdc-to-12Vdc power converter from **Diplomat Communication Systems**. The unit does not need the external heatsink-case, resulting in 95% operational efficiency. The unit is compact and runs cool, making it ideal for mounting in dashboards. The unit has a continuous power ouput of 6A and a surge rating of 8A.

Circle (413) on Fast Fact Card

Dependable solar electric power systems.

- Telecommunications
- Billboard Lighting
- Cathodic Protection
- Outdoor Lighting
- Radio Beacons
- Recreational Vehicles
- Remote Homes
- Water Pumping

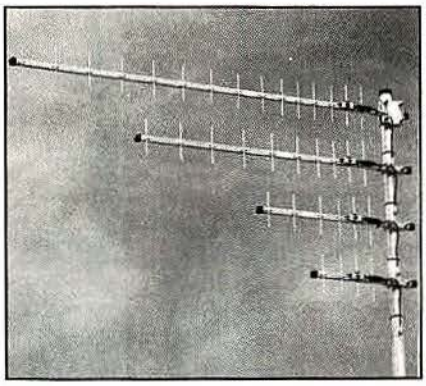
Call for a price quote and computerized CAD design.



Direct Power and Water Corporation
3455 A Princeton NE • Albuquerque, New Mexico
1-505/889-3585 or 1-800/260-3792

Circle (70) on Fast Fact Card

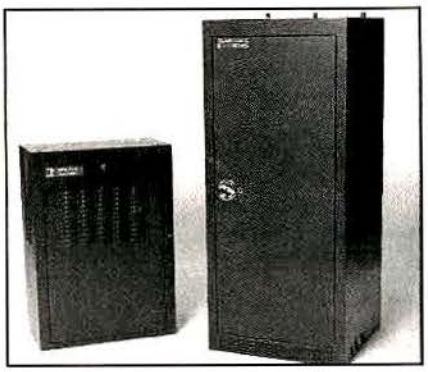
Antennas designed to withstand exposure to harsh environments



A set of yagi directional antennas is available from **Antennaco** for use in the 902MHz–928MHz band. They range from two-element antennas with 4dBd gain to 15-element yagis with more than 13dBd gain. Antennas are also available for systems operating from 896MHz–960MHz. The antennas use the company's "Ever-Sealed" feed system to provide long-term protection from exposure to harsh environments, and they are built using thick-wall, square tube booms to provide improved structural integrity. All antennas are delivered fully matched to 50Ω impedance.

Circle (414) on Fast Fact Card

Base station sports small size; transmits multiple frequencies



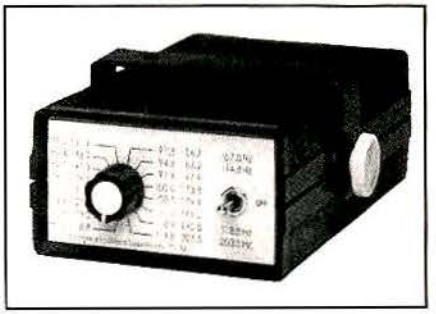
The Stealth slimline base station from **Eagle Telecom International** is a stackable, modular miniature base station that is fully synthesized and capable of high stability simulcasting. The unit measurements 11.5"D × 31.5"H × 22.5"W. The Stealth series can transmit multiple frequencies on UHF, VHF and 900MHz in power ranges as high as 500W. The unit comes with full-panel metering and displays, a fold-out work shelf and a lockable all-welded cabinet. Full diagnostic potential and high-speed data capability are optional.

Circle (415) on Fast Fact Card

Encoder allows users to access repeaters requiring CTCSS tones

Communications Specialists introduces a variation of its SS-32P CTCSS tone encoder. Model TE-32 provides direct access from a front dial rotary switch to all EIA CTCSS tones from 67.0Hz to 203.5Hz, allowing users to access repeaters that require CTCSS tones. The TE-32 is housed in a high-impact plastic case that measures 5.25" × 3.3" × 1.7" and is supplied with mounting bracket, hardware and three-foot shielded cable.

Circle (416) on Fast Fact Card



A TIME AND PLACE FOR TRAINING.

Finding time for product training is impossible AT TRADE SHOWS. CRUCIAL INFORMATION CAN BE LOST IN CROWDED SCHEDULES. *CMA is different.*

JUST FOR *mobile communications* MANUFACTURERS, DISTRIBUTORS AND INDEPENDENT REPRESENTATIVES, THE ANNUAL CMA CONFERENCE IS *three days set aside* FOR TRAINING, NETWORKING AND INDUSTRY EDUCATION. *No trade show distractions.*

DO *product training*, HIRE INDEPENDENT REPS, CATCH UP ON THE LATEST IN *marketing*, REGULATORY *news* AND HAVE A *great time* WITH YOUR PEERS (SATURDAY NIGHT'S *Western hoe-down* WILL BE A HIGHLIGHT).

SPEND *three days* IN ALBUQUERQUE -- *November 9-12* -- AND CHANGE THE *future* OF YOUR BUSINESS. IN ITS 23RD YEAR, CMA IS THE *premier event* FOR TRAINING AND NETWORKING.

for schedules and more information call:
Bernie Brownson -- 303.576.9475

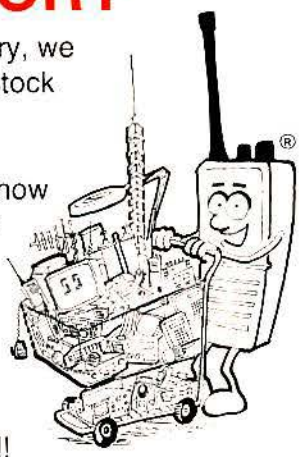
COMMUNICATIONS MARKETING ASSOCIATION 1995 MEETING
NOVEMBER 9-12 -- ALBUQUERQUE, NEW MEXICO
HEADQUARTERS -- ALBUQUERQUE DOUBLETREE HOTEL

Ad Design by E Comm Inc 520.620.0063

Circle (60) on Fast Fact Card

WE HAVE THE LARGEST INVENTORY

Tired of hearing " I´m sorry, we don´t seem to have it in stock right now...



At EPCOM, we know how important it is to maintain continues radio communications at its best !!!

LOTS & LOTS

of everything you need !!! Call us... and avoid the "I´m sorry.. " routine!

Over 3000 different products to choose from more than 200 manufacturers !!!

EPCOM
EL PASO COMMUNICATION SYSTEMS, INC.
1630 PAISANO DR.
(915) 533-5119 FAX (915) 542-4701
EL PASO, TX., 79901 U.S.A.

ASK FOR YOUR FREE CATALOG

U.S. Free Fax
1(800) 524-6564

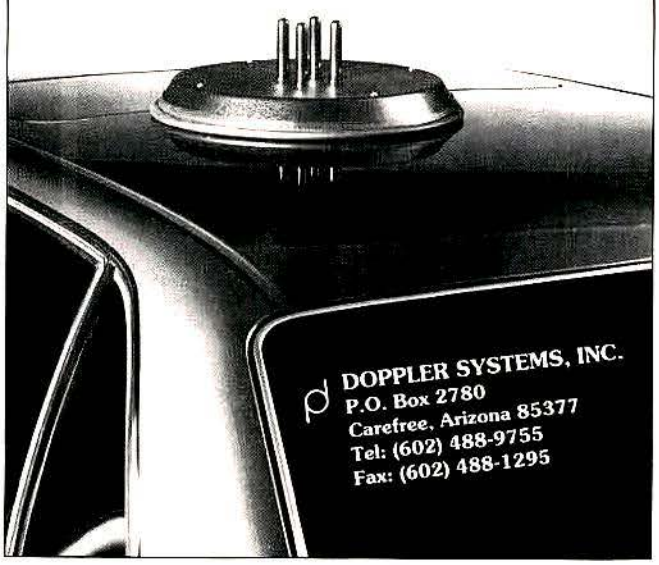
Circle (61) on Fast Fact Card

TRANSMITTER LOCATION

Direction Finding System Tracks Down

- **Stuck Microphones**
- **Cable TV Leaks**
- **Jammed Repeaters & Cell Sites**

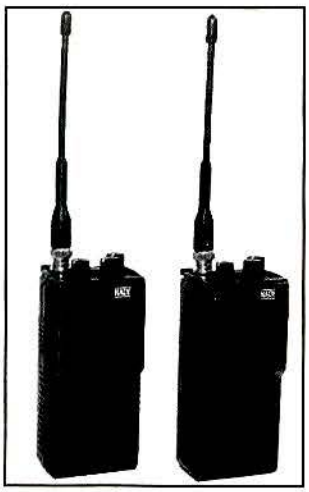
Models available with computer interface, synthesized speech, for fixed or mobile use, covering 50 MHz to 1 GHz. Call or fax for details



Circle (62) on Fast Fact Card

New products

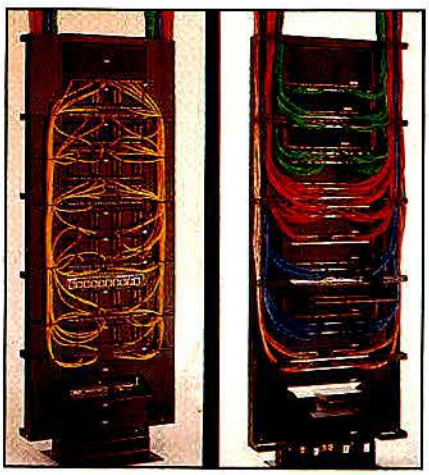
Transceiver combines compact size, full power output



The EasyTalk UHF-50 handheld combines compact size, full power output and four channels. The 5W portable weighs 15 ounces, and a top-mounted switch lets the user choose either 1W or 5W of power. A rugged impact-resistant case protects the unit from heavy use and harsh weather. The unit comes with a flexible "rubber duck" antenna with a BNC connector, an ac/dc wall charger, a stainless-steel belt clip, a protective holster-style carrying case and an 11V NiCd rechargeable battery pack. The radio operates in the 450MHz–470MHz band and comes with one standard channel installed. **Nady Systems** will add as many as three extra channels upon request.

Circle (417) on Fast Fact Card

Cable management system includes relay racks, wall-mount cabinets, wall-mount relay racks



A cable management relay rack system and wall-mount cabinets from **Hubbell Premise Wiring** are designed to maintain necessary bend radius, proper category 5 cable routing, strain relief and labeling identification. The system includes relay racks, wall-mount cabinets, wall-mount relay racks and relay rack accessories. Relay racks measuring 84"H × 19"W feature optional cable channels for vertical cable management, open channels for easy access, tapped mounting rails and pre-threaded holes for quick assembly. Wall-mount cabinets are fully assembled with locking doors and are available in two sizes: 24"H × 19"W × 20"D and 48"H × 29"W × 20"D.

Circle (418) on Fast Fact Card

Combiner handles 200W of input power per channel

Model DB806F combiner from the **Decibel Products** division of Allen Telecom Group handles 200W of input power per channel. It has been redesigned to be easier to tune, and it is optimized for any combination of frequencies. The combiner offers any-channel-to-any-port capability. Frequencies can be added or exchanged in any arrangement, and the unit uses standard cavity selectivity settings and standard phasing cables.

Circle (419) on Fast Fact Card

Literature

Catalog features test equipment, tools and supplies

A 48-page supplement catalog contains hundreds of new test instruments and tools for engineers, managers, technicians and hobbyists. Featured in this catalog from **Contact East** are products from many manufacturers for testing, repairing and assembling electronic equipment. Highlights include DMMs and accessories, soldering tools, custom tool kits, EPROM programmers, power supplies, ELF meters, reference books, milliammeters, wavemeters and breadboards. Also included are communication test equipment, scope meters, adhesives, measuring tools, precision hand tools, soldering and desoldering systems, inspection equipment and workbenches.

Circle (251) on Fast Fact Card

Analyst issues report examining APCO Project 25

A report called "A Need to be Heard: Will Project 25 Meet Public Safety Communications Needs in 1995 and Beyond?" by Charles L. Jackson, reviews APCO's Project 25. In the report Jackson, a Harvard and MIT graduate with a Ph.D. in electrical engineering, states that the association failed to produce a program to meet its stated goals. In the strategic policy research paper sponsored by **Ericsson,** Jackson specifies four areas where Project 25 is insufficient: He says it offers no short-term increase in spectral efficiency; He says it restricts competition over the system life cycle; He says it provides no technical solution to transmission between bands; and he says that current plans compromise important data transmissions.

Circle (252) on Fast Fact Card

Catalog describes uninterruptible power supplies

The SP795 14-page catalog from **Superior Electric** describes its SP series Stabiline standby uninterruptible power supplies that provide compact and efficient power quality solutions for PCs, workstations, POS systems and other electronic devices by instantly switching to battery power in the event of an ac power outage. The catalog includes graphs and tables that contain technical data on various models.

Circle (253) on Fast Fact Card

Selection guide covers full range of LMR cables

An expanded cable selection guide from **Times Microwave Systems** shows the full range of LMR cables. The guide compares performance and price of LMR cables to corrugated copper and other standard cables. It presents attenuation, power handling and dimensions, along with a guide to associated connectors that allows systems engineers to make the appropriate cable selection for mobile radio antenna feeder applications and other applications requiring low-loss cables.

Circle (254) on Fast Fact Card

SCADA supplier directory contains detailed business and technical information

The *Supplier Profiles Directory of SCADA Products, Systems and Services (SPD)* contains detailed business and technical information about 90 SCADA suppliers as well as information about the SCADA marketplace itself. Six sections, including alphabetical and geographical indices and the sales channel/advertising section, comprise the 350-page paperback volume from **AM/FM International.** The Profiles section was expanded to include engineering consultants and systems integrators, as well as the traditional equipment suppliers.

Circle (255) on Fast Fact Card

TOTAL RECALL



TOTAL RECALL in a TINY PACKAGE

Achieve total recall with the Model 3022 Instant Recall Recorder. With a little brawn and lots of brains, the Model 3022 accurately records emergency messages and totally recalls them without skipping or breaking a beat.

Remember these features:

- Fully self-contained
- Mounts into Motorola Centracom II or Series 3000 rack or desk adapter
- Up to 128 minutes of voice storage
- 100% solid state - no moving parts
- Multiple time sync sources
- ALI record/replay capability via RS-232 port
- Much more

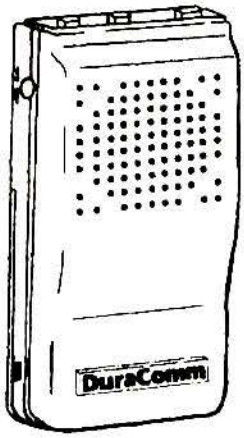
So, if you can't afford to take a chance with your instant recall capabilities and if you really want to save space, get TOTAL RECALL with the Model 3022 Instant Recall Recorder.

ZETRON

12335 134th Ct. N.E. Redmond WA 98052
Phone: (206) 820-6363 Fax: (206) 820-7031

Circle (63) on Fast Fact Card

Voice Pager & Scanning Monitor



VHF/UHF

- 2 Channel with Monitor Scan - User Selectable Priority
- Program up to 3 Individual Addresses on Each Channel No Reeds - Major 2-Tone Formats - PC Programmable
- Decode on Both Channels - Auto or Manual Reset
- Vibrator Option with Message Alert - Low Battery Alert
- AA Cell or Nickel Cadmium Packs - Charger/Amplifiers

Call Toll Free
1-800-467-6741
Fax 816-741-7499

The New Voice in 2-Tone Paging

DuraComm Corporation
Kansas City, MO 64150

Circle (64) on Fast Fact Card

häwa

Finally, a two-way radio package that's truly affordable!



- 16 Channels
- 5W/1W VHF-4W/1W UHF
- Leather Case
- Compact Charger
- Priority Channel Scan
- Time Out Timer
- PL Tones
- Nicad Battery
- Rugged Die Cast Frame
- 2 Year Warranty*

ONE LOW PRICE-$299 VHF or UHF

CALL US TODAY!
1-800-783-4239 • 1-404-921-3272
FAX 1-404-921-2896

Haewa Communications
A Division of Haewa Corporation
4357-B Park Drive
Norcross, GA 30093 USA

VISA/MASTERCARD & COD orders accepted

*One (1) Year on accessories

Circle (65) on Fast Fact Card

People

Barry L. Dorr, a senior engineer with Coded Communications, Carlsbad, CA, left in March 1995 to become a senior member of the technical staff at PCSI, San Diego. Exiting PCSI in August, he now operates his own technical consulting company in Carlsbad, specializing in modem design and communications system design.

Robert Ing, president of Databank Technical, Toronto, Ontario, Canada, is the winner of the 1995 Technician of the Year award presented by the Electronics Technicians Association. Ing began his electronics career as a technician and later returned to school to pursue studies in electrical engineering. His company provides antenna systems and wireless telecommunications consulting services.

Gordon Schlesinger leaves Southern California Gas Company, Los Angeles, as network engineering consultant to join Meridian Communications, Calabasas, CA, as technical operations manager.

Charles Feller departs Kaplan Organization, Edison, NJ, as executive project director to join Broadcast Communications, New Glarus, WI, as manager of the Applied Engineering and Construction Division.

Changes at Glenayre's Wireless Messaging Group, Vancouver, British Columbia, Canada and Quincy, IL:

Don Gayton, vice president of engineering in Vancouver, moves up to senior vice president of research and development for both the Vancouver and the Quincy, IL, facilities.

Mats Gerschman, vice president of the Vancouver manufacturing operation, advances to senior vice president of manufacturing for both Vancouver and Quincy.

John Linton, vice president of group marketing, moves up to vice president of paging and narrowband Personal Communications Services in Vancouver and Quincy.

Jim Marion, director of RF products, advances to vice president of radio products in the Quincy facility.

Jim Meckstroth, vice president of RF engineering in Quincy, advances to senior vice president of technical services for both the Quincy and Vancouver facilities.

Ted Browne leaves Digital Sound, Carpinteria, CA, as product marketing manager to join The Antenna Specialists division of Allen Telecom Group, Cleveland, as product manager.

Changes at Hutton Communications, Dallas:

Marty Eichenberger, branch manager for Seattle, advances to vice president and general manager of Hutton, Seattle.

Steve Schreivogel, branch manager for Denver, moves up to vice president and general manager of Hutton, Denver.

David Cannane departs KDI Precision Products, Cincinnati, as senior engineer to join Cartwright Communications, Cincinnati, as senior systems engineer.

Changes at Geotek Communications, Montvale, NJ:

Jonathan C. Crane exits MCI Telecommunications as executive vice president of multinational accounts to join Geotek Communications as president of Geotek U.S. Business.

Michael McCoy, vice president of Northeast regional operations for Geotek, advances to senior vice president.

Letters from readers

Is this a $10 million tower?

About three years ago, Viking Communications, Milwaukee, purchased and installed a functional 200-foot tower from a national railroad. The tower is on excellent ground, and its central location allows it to serve metropolitan Milwaukee, including Milwaukee and Waukesha counties (the two largest counties in Wisconsin) and parts of the surrounding counties.

Research, historical information and computer-generated radio coverage contours indicate this location is ideal for a 500-foot tower. In addition to its ground level of 1,040 feet above sea level, the location does not interfere with air traffic that uses the local airports. Lake Michigan, which is 580 feet above sea level and about 20 miles to the northeast, is at the eastern edge of several of the counties covered by radio from this tower.

A review of zoning codes revealed little to prevent obtaining a permit to raise the tower height to 500 feet. A new tower meeting current, stricter, State of Wisconsin standards was planned. We purchased the site and applied for a Federal Aviation Administration (FAA) permit. After several months and little red tape, we received FAA approval. FAA staff members were quite helpful. After receiving FAA approval, we applied to the State of Wisconsin Bureau of Aeronautics. After a few months, the state gave its approval. State employees were quite helpful, too.

With possession of the land and approvals from the federal and state governments, we applied to the city government for a building permit. We were reasonably confident that the permit issuance would go smoothly because the proposed tower did not appear to conflict with any restrictions.

After we applied to the city government, we learned that the city apparently had been notified by the state government of our plans. Unbeknownst to us, the city took action to change its zoning ordinance to block our plans. This revelation was quite a shock, and we proceeded to do what we could to resolve the situation.

After months and months of meetings with city officials—during which the FAA and State of Wisconsin permits expired and had to be renewed—city officials set before us a series of hurdles. They demanded all sorts of tests, many of which seemed unnecessary and unreasonable. Soil percolation tests were requested in spite of the fact that no water service or sewerage was contemplated for installation at the site.

In addition, the zoning Ordinance was changed once or twice during the three-year process. No one in any position to know is quite sure how many times the ordinance was revised, or for that matter, why it was revised. One section of the new ordinance would require in excess of $100,000 worth of landscaping at the site. This requirement seemed somewhat out of line, considering the fact that landscaping would do little to hide or conceal a 500-foot tower.

Another new problem was that the setbacks from the road and side lots had been increased such that considerably more land was required to fit a 500-foot tower. This change may have been an attempt to increase construction cost and reduce profitability and thereby discourage the project.

As time went on, we noticed that every request or decision took the maximum time allowed by law for processing. We also noticed that there were different regulations for guyed towers than for self-supporting towers. For whatever reason, self-supporting towers can be placed much closer to roads and side yards than guyed towers, which seems inappropriate, especially in view of the considerably larger base of the self-supporting tower. No city official has been able to explain the reason.

We learned some valuable lessons with this project. Be careful when talking with city officials. They do not always mean

No Power, Bad Roads, A Long Way From Home,

It's time to call Photocomm



Photocomm is the world's leading supplier of wireless solar electric power systems for the telecommunications industry. For over a decade we've traveled the world providing cost effective power solutions for remotely located sites. Call for a complete catalog of pre-engineered wireless power systems and products.

KYOCERA

PHOTOCOMM, INC.
THE WIRELESS POWER COMPANY
7681 East Gray Road, PO Box 14670
Scottsdale, Arizona 85267-4670 U.S.A.
1-800-223-9580 • 602-948-8003 • Fax 602-483-6431

"If you have a power problem we've already solved it"

Circle (66) on Fast Fact Card

Don't let the low price fool you.



It's a recurring theme. Whenever we explain how powerful and comprehensive ServicePlus is, people can't believe that they can get a total service information system for such a low price.

From a single point of entry (Logbook), you can access accurate customer data, equipment history, technicians, suppliers, service contracts, inventory and dispatch. This modular system uses look-up tables and preset defaults to make Work Order data entry and information retrieval fast and easy.

ServicePlus modules include:
- SP Manager
- Logbook (Work Orders/Invoicing)
- Inventory Control
- Service Contracts
- Dispatch
- Purchase Orders
- ACCPAC Plus™, Great Plains™ or SBT™ Accounting Interface

ServicePlus® Service Information System

Hottest Price/ Performance in its class!

$2780

Buys you SP Manager, Logbook, Inventory Control, and Purchase Orders.

ServiceWare Corporation
Tel: (613) 521-7391
Fax: (613) 521-5595
BBS/Demo: (613) 521-2105

Circle (67) on Fast Fact Card

Santa Fe Distributing has a complete line of Base Station/Mobile Antennas, Duplexers/ Combiners, and Coaxial Cables & Connectors!

ANTENEX
BAND-IT
ASTRON CORPORATION
RFS Cablewave Systems
COMTELCO
fipleX
BIRD
Belden Wire & Cable
TELEWAVE, INC.
RFI
HUSTLER
cushcraft/Signals
Larsen
ROHN
PolyPhaser CORPORATION
SHURE
SPECO
Shakespeare
SINCLAIR
uniden
WAVETEK
tanna
PHASE III
HENRY RADIO
TRIPP LITE

SFD
SANTA FE Distributing, Inc.
9640 Legler Rd. • Lenexa, KS 66219 • 913-492-8288
Call Toll Free: 1-800-255-6595
FAX: 800-255-6596
For Fast, Easy Ordering!

Circle (68) on Fast Fact Card

Letters from readers

what they say. If possible get everything in writing or "on the record."

We also had to contend with neighbors. Although only one neighbor lives nearby, and he built his house long after the 200-foot tower was in place, he was able to raise some opposition to our project.

Although the opposition soon disappeared, during several meetings we had to listen to all sorts of objections, such as two elderly persons stating that they had contracted cancer from our tower. Elderly persons can be a powerful force at city meetings, especially if they are weeping.

There were objections to the possibility of falling ice. Several engineering studies we contracted discounted the danger of falling ice based on the tower's distance from the side lot and roadway. Also, we checked with a U.S. tower insurance company and found that for the past three years, its database showed that there had been no tower claims of any kind.

There was an objection to the possible safety risk of a tower collapse. Again, we went to the engineers, who said that because the footprint of a tower collapse can be predicted, and in our case the tower, if it were to collapse, would collapse completely on our property, there was not reason for concern.

The tower's possible effect on property values was another objection. I studied property values on nearby tower sites and found that, for whatever reason, the property values of $200,000 homes adjacent to a nearby tower rose faster than other properties in the city.

As a sidenote, the city elected to construct a 150-foot tower of its own that violated all the city regulations concerning tower structures. It was erected adjacent to a large public safety facility.

In July, we filed a "Notice of Claim" with the city in the amount of $10.2 million. Since serving the city with the notice, we have received no official response other than a receipt acknowledgement.

This description is only a partial accounting of what we have been put through by the city. By now, nothing else the city might do would surprise me.

I would appreciate hearing from any readers with helpful information, a referral to information sources or to knowledgeable people. One of the most helpful sources, by the way, has been the American Radio Relay League.

Sal Dragotta
Viking Communications
1421 S. 62nd St.
Milwaukee, WI 53213
414-771-8960
FAX 414-771-8074

Mobile Radio Technology™
The journal of mobile communications technology

BUSINESS
Cameron Bishop, *Senior Vice President*
Mercy Contreras, *Publisher*
Darren Sextro, *Associate Publisher*
Kathryn Buckley, *Promotions Manager*
Denise Kettler, *Senior Promotions Coordinator*
Liz Turner, *Senior Advertising Production Coordinator*
Nancy Hupp, *Advertising Production Manager*
Dee Unger, *Director Advertising Services*
Tammy Kalebaugh, *Classified Advertising Coordinator*
Tom Cook, *Group Senior Managing Editor*
Doug Coonrod, *Corporate Art Director*
Kim Bracken, *Art Director, Special Projects*
Stephanie Hanaway, *Group Director of Ancillary Products*

Raymond E. Maloney, *President and CEO*
Nick Cavnar, *Vice President of Circulation*
Barbara Kummer, *Circulation Director*
Michele Bartlett, *Senior Circulation Manager*
Customer Service, *800-441-0294*

ADVERTISING SALES OFFICES:



ENGLEWOOD, COLORADO

Carla M. Gamino, *303-220-4244, East region (including Eastern Canada)*
Mercy Contreras, *Publisher, 303-220-4245*
5660 Greenwood Plaza Blvd., Suite 350
Englewood, CO 80111
Phone: 303-793-0448
Fax: 303-793-0454

OVERLAND PARK, KANSAS

Joyce Bollegar, 913-967-1840, *Midwest region,*
Fax: 913-967-1901
Rick Kelley, *Classifieds*, 913-967-1923,
Fax: 913-967-1735
Lori Christie, *List Rental Services Representative*, 913-967-1875, Fax: 913-967-1897
9800 Metcalf Ave.
Overland Park, KS 66212-2215

SAN RAFAEL, CALIFORNIA

Dennis Hegg, *West region (including Alaska, Hawaii and Western Canada)*
950 Northgate Drive, Suite 207
San Rafael, CA 94903
Phone: 415-491-1442
Fax: 415-491-1842

OXFORD, ENGLAND

Richard Woolley, *International*
Jane Moseley, *International*
Unit 3, Castle Farm Business Centre, Clifton Road
Deddington, Oxford, OX15 4TP, United Kingdom
Phone: +44 (0)1869 338794
Fax: +44 (0)1869 338040

Professional services

PORTA-TECH PORTABLE TECHNICAL SERVICE, INC.
121 Crowell Lane • Lynchburg, VA 24502
GE Portable Radio Service Depot
Factory Approved Nationwide
• Current Product Lines
• Voice Guard Certified
• Public Service Trunking
• Surface Mount Technology
FACTORY TRAINED TECHNICIANS FOR QUALITY SERVICE
(804) 239-3049

Telecomm Engineering Inc.
maxon® Portable Service
CP0500, CP1000, SP2000 Series
• Factory trained technicians
• $50.00 flat rate plus parts
• Battery conditioning included
• Warranty • Return UPS paid
3435 Mission Ave., Carmichael, CA 95608
(800) 420-5166

BROWN AND SCHWANINGER
Attorneys At Law
1835 K Street, N.W.
Suite 650
Washington, D.C. 20006
202/223-8837
SERVING THE NEEDS OF THE ENTIRE INDUSTRY

OMNICOM, Inc.
COMMUNICATIONS ENGINEERING
GENE A. BUZZI
PRESIDENT
930 THOMASVILLE ROAD SUITE 200
TALLAHASSEE, FLORIDA 32303
PHONE (904) 224-4451

FREDERICK G. GRIFFIN, P.C.
3229 Waterlick Road
Lynchburg, VA 24502
(804) 237-2044
NATIONWIDE COMMUNICATIONS CONSULTING
Mobile Radio, Microwave, E9-1-1,
CAD, Paging, LAN,
Dispatch Communications Centers
Multi Site Propagation Analysis

TCS
Jerry L. Simmons
Communications Systems Consulting
Land Mobile, SCADA, & Microwave Systems
Tower & Path On-Site Surveys
P.O. Box 884 PH: (409) 588-3200
Montgomery, TX 77356 Fax: (409) 588-4434

MCCON
Mobile Communications Consulting
S. R. McConoughey, P. E.
Principal
13017 Chestnut Oak Drive
Gaithersburg, MD 20878 (301) 926-2837

HERB SACHS, CONSULTING
Specialist in Public Safety Communications
P.O. Box 729
Bowie, MD 20715
301-464-4268

TROTT
COMMUNICATIONS GROUP
RAYMOND C. TROTT, P.E.
President
1425 Greenway Drive, Suite 350, Irving, Texas 75038
214/580-1911, Fax: 214/580-0641

THE PORTABLE DEPOT, Inc.
SPECIALIZING IN GENERAL ELECTRIC PORTABLE SERVICE
• FACTORY TRAINED TECHNICIANS •
• SURFACE MOUNT TECHNOLOGY •
• FACTORY APPROVED NATIONWIDE •
• PUBLIC SERVICE TRUNKING •
• VOICE GUARD CERTIFIED •
• MPD, MPA, TPX, PCS AND ALL CURRENT PRODUCTS •
Route 2, Box 338C • Lynchburg VA 24501
804-237-3427

The Art and Science
of
Antenna Site Acquisition
RETCOM brings together all the resources needed to create a masterpiece of network design options through the site acquisition process. We have been antenna site specialists since 1986, providing the most cost-effective array of site acquisition services available.
Let RETCOM do the job for you!
RETCOM, INC.
a subsidiary of Trott Communications Group, Inc.
1425 Greenway Drive #355
Irving, TX 75038
214/550-0320
Fax: 214/580-0641

Webster
Since 1974 Your Factory
AUTHORIZED BIRD DISTRIBUTOR
115 BELLARMINE, ROCHESTER, MI 48309
TOLL FREE 800-521-2333
FAX 810-375-0121

GE PORTABLE SERVICE
• FAST TURN
• WARRANTY
• $48.00 hr./2 hr. MAX
• PARTS GE LIST
• RETURN UPS PAID
Smith Communications Service
2121 W. Parrish Ave., Owensboro, KY 42301
502-683-0936

Communications Technology Associates
A division of Hayes, Seay, Mattern & Mattern, Inc
PLANNING AND DESIGN:
• 2-Way Radio
• MW & F/O
• CAD/MDT/AVL/Paging
PLUS:
• Complete A&E Services
• Bldgs, Towers, Pwr Sys
• Structural Engineering
Bus. (804) 239-9200 P.O. Box 4579
FAX (804) 239-9221 Lynchburg, Virginia 24502

USE COLOR

Category Index

Business Opportunity	pg 87	Professional Services	pg 71
Computer Software	pg 83-84	Rentals	pg 87
Employment	pg 72-73	Reprints	pg 87
Equipment For Sale	pg 77-82	Repair Services	pg 86
Equipment Wanted	pg 84	Technical Services	pg 86
Pager Repairs	pg 74	Tower Services	pg 86
Paging	pg 73-74	Tower Space	pg 85
Prof. Consulting Services	pg 72		

Professional consulting

Pacific Consulting Services
- Radio Coverage Studies
- Feasibility Studies
- System Evaluation & Design
- Project Management
- Specializing in Public Safety

P.O. Box 91, Hoodsport, WA 98548-0091 (206) 947-2210 fax (360)877-9577

Classified

Professional consulting services

COMMUNICATIONS CONSULTING SERVICES

- ☑ Mobile Radio Systems
- ☑ Mobile/Portable Data Systems
- ☑ Computer Aided Dispatch Systems
- ☑ Basic And Enhanced 9-1-1 Systems
- ☑ Telephone Networks
- ☑ Microwave Radio Systems
- ☑ Vehicle Location Systems
- ☑ Fiber Optic/PCM Transmission Systems
- ☑ Full GIS Services

PLANNING, DESIGN, IMPLEMENTATION

RAM

10 Woodbridge Center Drive
Woodbridge, NJ 07095
(908) 636-6970

COMMUNICATIONS CONSULTANTS, INC.

Toll-Free: (800) 247-4795 • FAX (908) 636-7260

Offices Nationwide and International

Circle (75) on Fast Fact Card

Successfully Target *New* Business...



CALL: RICK KELLEY

(913) 967-1923

Fax (913) 967-1735

TCS

CONSULTING SERVICES
- Microwave Systems
- 2-Way Radio Systems
- Telemetry / SCADA Systems
- Path Survey & Analysis
- Specifications & Licensing

ENGINEERING AID SOFTWARE
- Microwave Calculations
- Path Profiles (Graphics)
- Mobile Coverage
- Multi-Point Calculations
- HAAT Calculations

U.S.G.S. MAP DATA BASE: 30 SECOND & 3 ARC SECOND DATA BASES

CONTACT: JERRY SIMMONS

P.O. BOX 884, Montgomery, TX 77356 • (409)588-3200 • FAX (409) 588-4434

Employment

CITY OF RICHLAND, WASHINGTON
ELECTRONICS TECHNICIAN I (COMMUNICATIONS)
REGULAR FULL TIME POSITION, SALARY: $22.82 HOURLY
CLOSING DATE: NOVEMBER 17, 1995.

Under the direction of the Technical Services Supervisor, to perform technical work skilled in the installation, maintenance and repair of various electronic and communication equipment including traffic signals and fire alarm systems; locate radio frequency interference using specialized equipment and prepare and maintain records and reports related to assigned activities. MINIMUM QUALIFICATIONS: Any combination equivalent to High School graduation, certification from one of the following: NABER, ISCET, OR FCC in radio communications and five (5) years experience in the repair of mobile radios, base stations, and microwave equipment. Must posses a valid Washington State driver's license within two months of hire. APPLICANTS ARE RESPONSIBLE FOR SUPPLYING ALL INFORMATION RELATIVE TO THEIR QUALIFICATIONS FOR THIS POSITION. FOR MORE INFORMATION CALL THE PERSONNEL OFFICE AT (509) 943-7391. SUBMIT EMPLOYMENT APPLICATIONS TO CITY HALL, CITY OF RICHLAND, 505 SWIFT BLVD. PO BOX 190, RICHLAND, WA 99352. FAX NO. (509) 943-7345. EOE.

RADIO MICROWAVE ENGINEERS

• CELLULAR • PCS •

PERMANENT & CONTRACT POSITIONS AVAILABLE

FIRST SEARCH

6584 N.W. Hwy., 1st Fl.,
Suite MRT, Chicago, IL 60631
Phone (312) 774-0001
FAX (312) 774-5571
email: lsihunter @ aol.com

EMPLOYER INQUIRIES WELCOME

Technicians Wanted

Motorola MSS is seeking several technicians to fill current openings for experienced field and bench technicians.

Advanced Communications & Electronics

505-244-3321 Fax: 505-244-3675

Albuquerque, New Mexico

Employment

Paging / PCS / RF / 2 Way Radio / Cellular / SMR / Microwave /

CNI

CareerNetworks

Recruiters & Consultants for the Wireless & Telecom Industry

800-JOB LINK™

Specializing in all levels of Sales, Marketing, Technical, Engineering, Operations & Executive Placements

Gables One Tower
1320 S. Dixie Hwy., Suite 801
Coral Gables, FL. 33146
Fax: (305) 665-5633
cni022@aol.com

TWO-WAY TECHNICIANS

GLOBE, ARIZONA, MSS SHOP IS LOOKING FOR TWO-WAY TECHNICIANS EXPERIENCED IN ALL MOTOROLA EQUIPMENT, INCLUDING PAGERS, PORTABLES, MOBILES, REPEATERS, BOTH CONVENTIONAL AND TRUNKING, NEW AND OLD.

WORK INCLUDES: BENCH REPAIRS, FIELD REPAIRS, TOWER WORK, AND INSTALLING.

MUST BE FCC LICENSED, NABER CERTIFIED OR EQUIVALENT.

PLEASE SEND RESUME TO OR CALL:

ROY D. HUDGINGS
SHORES COMMUNICATION CO., INC.
P.O. BOX 2626
GLOBE, ARIZONA 85502
PHONE: (520) 425-5870

COMMUNICATIONS SUPERINTENDENT

$42,110-$63,164 (DOQ)

(On-call 24 hrs)

Supervises daily operations of installation, repair & maintenance of radio, telephone, microwave, SCADA, fiber optic & data equipment & RFI/TVI complaints, outages & malfunctions. Analyzes & resolves problems related to communication systems. Requires 6 yrs communication construction & maintenance experience, plus 2 yrs in supervisory or lead capacity. Thorough knowledge of communications equipment, standards, practices, procedures, techniques, operations & functions; and FCC rules & regulations pertaining to installation, maintenance & repair of telephone, microwave & radio equipment. Prefer mobile or other radio installation & maintenance, electric utility experience, BA in Communication Engineering or equivalent.

Complete benefits plan & WA State Retirement program. Send cover letter & resume to:

Snohomish County PUD,
Attn: Employee Resources, P.O. Box 1107,
Everett, WA 98206.
Or call: (206)258-8655;
(800) 562-9142 (within WA).
We are an EEO employer...
commited to a diverse workforce

ELECTRONICS / 2-WAY RADIO SYSTEMS ENGINEERS

43 YEAR MOTOROLA MSS SERVING 26 COUNTIES FROM 6 LOCATIONS IN MICHIGAN HAS IMMEDIATE OPPORTUNITIES. MANAGEMENT & TECHNICAL EXPERIENCE ONLY, PLEASE. CAREER BENEFITS. CALL OR FAX RESUME' TO: TELE-RAD, INC. HAROLD TIMMER 1-800-456-5619 FAX: 616-392-9707

Classified

Employment

CELLULAR TWO-WAY PAGING PERSONNEL SERVICES

Technical & Engineering Positions Available Nationwide
Fees client paid. Send resume to address below.

ALL LEVELS OF POSITIONS FILLED NATIONWIDE
• Technicians • Engineers • Managers • Sales
•Extensive national resource of personnel
Employers: Call 606-491-5410 10 AM to 8 PM

Communication Resources
P.O. Box 141397 • Cincinnati, OH 45250
606-491-5410/FAX 606-491-4340

PUDGET SOUND, WASHINGTON

MSS Full Line Dealer seeking individual with extensive Motorola experience. FCC or NABER certificate required. Work in relaxed atmosphere, with complete benefits.

Send resume to:

Strata Communications
3501 Everett Avenue
Everett, WA. 98201
or Fax:
206-339-2366

TWO WAY RADIO TECHNICANS WANTED

To work in a South Florida Motorola Service Depot. Must have extensive background in Motorola equipment, including Fixed Base, Voting systems and portables. Must have a minimum of 3 years experience with FCC/Naber certification highly desired.

System Test Engineer Wanted

to develop and execute test plans and test infrastructure of communication system. Hardware and software background is required with a knowledge of cellular or large communication systems being desired. Must have a minimum of 3 years experience.

Send Resume to:
Aerotek
5100 nw 33rd Ave. #261
FT. Lauderdale, FL 33309
(800) 487-1322
email: aeroftl@gate.net

Sky Wire Inc.
PCS
PAGING
RF, SMR
MICROWAVE
MANY OPPORTUNITIES!!
605 Lexington Avenue
Charlotte NC. 28203
Fax 704-334-6577
Tel 800-409-4509 / 704-334-0853

WIRELESS RECRUITING & TECHNICAL TRAINING

WAVETEK

Wavetek CATV/Communications Division, a division of Wavetek Corporation, is a world leader in communication test equipment offering state-of-the-art test equipment for new and evolving markets. This high profile position is an excellent opportunity for an energetic, enthusiastic and self-confident individual who desires to contribute to a highly motivated team in an entrepreneurial environment.

APPLICATIONS ENGINEER

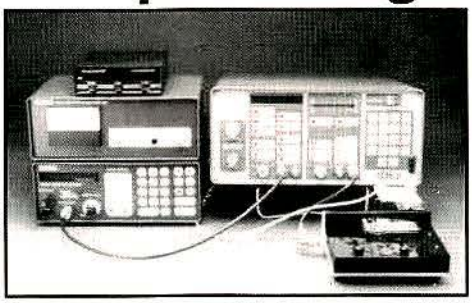
Will design, create, document, maintain, support and train customers in the use of automatic radio base site test systems. Includes 10-20% field work on odd shifts. BSET degree or equivalent experience required, with a strong background in practical field testing of radios and radio systems. Must be proficient in the use of RF test equipment, with programming experience in BASIC and PASCAL.

In addition to providing a challenging and rewarding experience, Wavetek offers a competitive salary and benefit package. Qualified candidates may send resume to: **Wavetek, 5808 Churchman Bypass, Indianapolis, IN 46203 or fax to: 317-788-5999, Attn: H.R.**

Wavetek is an Equal Opportunity/Affirmative Action Employer

Paging

Complete Pager Testing...



Quickly and Easily Tests
- All Popular Pagers
- Pocsag, Golay, & NEC digital paging formats
- 512 to 2400 Baud Rates
- Alignment & Sensitivity
- Fast Verification of Re-Crystalling Jobs

Includes...COM-3 Communications Service Monitor ($2,995), COM-6 Universal Encoder ($995), RTF-1 Radiation Test Fixture ($465), CT-125 Frequency Counter ($190), SM-1 Automatic SINAD Meter ($250), all interconnect cables, shipment to your door, and a quick hook-up guide for fast set-up and immediate profitability! Shipments going daily! **Complete package only $4,995.** Leasing available. Call now and be testing tomorrow!

RAMSEY ELECTRONICS, INC.
793 Canning Parkway, Victor, NY 14564

VISA MasterCard DISCOVER

CALL 1-800-446-2295
FAX 1-716-924-4555

Circle (76) on Fast Fact Card

CRYSTRONICS
the one stop shop for crystals & pager parts
1,600 FREQS
Motorola, NEC, Uniden, Samsung, Everon & more
at your door overnight!
tel 305-776-0031 fax 305-776-0109
+pager parts, LCDs, housings & more
PAGER PARTS UNLIMITED

Circle (77) on Fast Fact Card

Paging

SENTRY MANUFACTURING COMPANY
PAGER & RADIO CRYSTALS
800-252-6780
28 Years in the Crystal Business • Customer Service Second to None
100% Quality Control Tested • No-Hassle Lifetime Warranty
Very Large Stock of Pager Crystals • Overnight Shipping Available
Scheduled Shipments & Purchase Agreements Arranged
Channel Elements & Tone Reeds Also Available
Sentry Crystals Are "Rock" Solid TVB

Circle (78) on Fast Fact Card

WE SELL USED PAGERS!



We also carry new pager accessories! Call for details!

RMS Communications Group, Inc.
1-800-627-2022
5100 W. Silver Springs Blvd.
Suite 700, Ocala, FL 34482

For quality that is consistent and reliable, look to RMS Communications. We buy used pagers, too!

Circle (79) on Fast Fact Card

Pager Repair

COMPLETE PAGER REPAIRS
ALL MAKES AND MODELS

Programmers
Password Erasers
Pager Components
New & Used Pagers
Top $$$ for Used Pagers

TURNAROUND GUARANTEED!
48 HR

Decode, Recrystal
LCDs replacement
Total Repair &
Reconditioning

PageCo International, Inc.®
tel 305-491-9501 **fax 305-491-8834**

Circle (80) on Fast Fact Card

SAFARI RADIO Motorola 2-Way Radio Sales
RADIUS P110s
6-Channels
4W UHF...$405
5W VHF...$375
Low! Low! Low Prices!
1-800-RADIO-80

Equipment for sale

PAGING AMPLIFIERS
UHF-900/800MHz
40 to 300 watts, continuous duty!
Electronically protected, + 2 yr. warranty.
1-800 -LH-AMP-4U 310-865-4923
LH Power Amplifiers, Inc.

ALT
PAGER REPAIR LABELS IN 2 SECONDS
(CAP CODE, BAR CODE, frequency, & reward)
Software, printers, scanners, labels, and SYSTEMS
ADVANCE LABEL & TAG
1725 N. McDonald ✦ 1-800-466-5345
McKinney TX 75069 FAX 214-548-2518

Pager Repair

PT TECHNICAL SERVICES

- Motorola & NEC Pager Repair
- LCDs - Recrystal - Repair
- Fast turn around
- Factory Parts
- Accurate in-house tracking system

1-800-263-3193
4328 So. Mingo
Tulsa, OK 74146

Equipment for sale

USED EQUIPMENT
BUY-SELL

- LTR & Motorola
- Conventional & Trunking
- Site Equipment
- Paging Transmitters

STERLING COMMUNICATIONS
Mike Malone
1-800-786-2199
FAX 214-562-7957

New / Used Reconditioned 2-WAY RADIOS

- Purc's, repeaters, base stations, mobiles & portables
- LB's / VHF / UHF / 800-900 MHz
- Large inventory of late model equipment

Call for quote
We pay the highest prices!
SCOTT COMMUNICATIONS
Ken Scott
406-745-3218

Equipment for sale

L C D's



Superior Japanese Quality!

GUIDE HOLES FOR EASY INSTALLATION
" MICRO PRINTED " FOR EASY ID
LOW FACTORY DIRECT PRICING
NOW IN STOCK : BRAVO • PLUS • LS PLUS
EXPRESS (NEW AND OLD VERSION)

1-800-FIX-BEEP
1-718-783-6000

USED RADIOS
at Low Prices!

- MICOR
- MITREK
- PORTABLES
- MOCOM 70
- MAXAR
- RPTRS
- GE
- RCA
- ACCESSORIES
- TONE ELEMENTS
- CHRYSTAL ELEM.
- BASE STATIONS

Large Quantities • (817) 433-5452

USED EQUIPMENT SALE

LOW BAND:	
1 WILSON HH506 (40-50) 5W, 4F, CS, 25W VEH. CHARGER	$225
1 MOTOROLA MT-500 (42-50) 5W, CS, RAPID CHARGER, CASE	$225
1 MOTOROLA MICOR (42-50) 100W, PL, 2F, W/A	$175
1 MOTOROLA MOTRAC (42-50) 100W, PL, 2F, W/A	$100
1 NUETUC SM-1645, 45W, 16F, SYNTH	$225
3 REGENCY BTL-304 (30-48) 30W, 4F, CB	$100
1 MOTOROLA MOXY, 60W, PL, 1F	$125
1 MOTOROLA MOCOM 70, 100W, 2F, W/A	$90
HIGH BAND	
1 MAXON CP-0510, 5W, 4F, CS, W/CHARGER	$100
4 REGENCY BTH-201, 20W, 1F, PL	$90
5 REGENCY MCH-44B, 40W, 4F, PL	$100
3 MAXON CM-4010 BASE STATION, 40W, 4F, PL	$250
UHF	
3 GE PE, PY 5W, 1F, CG, RAPID 3 CHARGER	$100
8 UNIDEN APU42K, 4W, 2F, PL	$150
2 MOTOROLA HT-90, 2F, 4W, PL, RAPID CHARGER	$175
1 MOTOROLA HT-10, 5W, 2F, PL, DESK CHARGER	$200
3 MAXON CP-0520-HD, 5W, 4F, P... CHARGER	$150
4 WILSON HH464D4, 5W, 4F, CG, RAPID CHARGER	$100
1 MIDLAND 70-530B, 30W, 99CH, SYNTH, CG	$150
2 MAXON CM-4020, 30W, 4F, CH	$175
3 JOHNSON PPL-6000, 20W, 2F, CG	$225
2 GE PHOENIX SX, 25W, 2F, SYNTH, NEW ACCESS	$200
3 MOTOROLA MOXY, 30W, 1F, PL	$150
1 MOTOROLA MAXAR BASE, 1F, PL, ASTRON PS	$225
5 GE CENTURY II, 20W, 1F, CG	$180
1 GE CENTURY II CONT. STATION, 5W, 1F, PS	$250
4 UNIDEN FMU 250K, 25W, 36F, SYNTH	$225
3 FUJITSU TEN FTM-40, 30W, 16F, PL	$229
5 JOHNSON PPL-6000 BASE, 20W, 2F, PL	$299
2 GE CUSTOM MVP, 25W, 1F, CG	$175
1 UNIDEN AMU-0080, CONT. STATION, 2F, PL, LESS PS	$100
MISC	
3 GE MASTR PRO UHF REPEATERS, 60W CONT. DUTY	$500
1 GE PE/PY CONVERTACOM	$50
1 RF GAIN RF1545U AMP, 15W IN-45W OUT (NEW)	$110
1 MOTOROLA MAXAR 800, TRUNKED MOBILE	$275
50 MAXRAD MLB-3000 USED LB COILS W/ WHIPS	$5
30 A.S.P. SERIES 30 MHZ USED LB COILS W/WHIPS	$5
TECH SPECIALS: (NOT CHECKED AS IS)	
3 MOTORCLA MT-500 CONVERTACOMS N/A	$5
6 MOTORCLA MOXYS, UHF, 1F, PL	$30
9 GE CUSTOM MVP, UHF, 1F, CS, TOT	$35
1 GE PE UHF, 8F, CG	$20
8 NEC R304 VHF DIGITAL PAGERS	$5
1 REGENCY MCPU-401, UHF, 4W, 1F, PL	$25

WAYNE COMMUNICATIONS
ROCHESTER, NY (716) 427-0830 FAX: (716) 427-7163
ALL PRICES ARE PLUS SHIPPING C.O.D. CAH–$25 MIN. ORDER

C. W. WOLFE COMMUNICATIONS

BUY SELL TRADE All Brands of 2 Way Radios and equipment

1113 Central, Billings, MT 59102 — *Call or write for current flyer.* — 406-252-9220 Fax: 406-252-9617

For Sale:
Motorola PURC and Quintron QT Stations 40-50 Mhz; 300w, with 900 Mhz. link Rx. High stab osc. Excellent Cond.
(415) 456-6000

RADIUS PRICE REDUCTION

TONS IN STOCK - MORE ON THE WAY - WE NEED OUR SPACE!
OUR PAIN IS YOUR GAIN
HUGE DISCOUNTS! EVERY RADIO INCLUDED IN THIS SALE!
SP50 - P110 - GP300 - M10 - M120 - GM300 - GR300
ALL ARE IN STOCK AND CAN ABSOLUTELY BE SHIPPED TODAY!

SPECIALS
SYNTOR X 9000 30-50 Mhz $995. STX SMARTNET $1495.

WE HAVE A LIMITED SUPPLY OF NEW & RECONDITIONED RADIOS
HT600/VISAR/HT1000/MT2000/MARATRACS/SPECTRAS/MAXTRACS

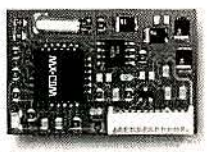
MOTOROLA TRUNKED RADIOS
MAXTRAC 800 & 900 • SPECTRA 800 & 900 • MTX 800 & 900
VISAR • MTX8000 • MTX9000 • MAXTRAC-DUPLEX/PP1000X
ALL ARE IN-STOCK FOR IMMEDIATE SHIPMENT AT LOW PRICES

RADIO EXPRESS, INC.
INFO 703-266-1928 FAX 703-830-8710 ORDERS 800-545-7748
ALL CREDIT CARDS ACCEPTED - WE BUY LATE MODEL MOTOROLA RADIOS

Circle (81) on Fast Fact Card

THINK OF IT AS YOUR WATCHDOG FOR THE AIRWAVES.





***Pvt* SQUELCH™ voice privacy modules are easily installed in most popular radio brands including the Radius GP300™.**

Radio messages are property and, if left unprotected, can legally fall victim to anyone listening in. MX·COM's voice privacy adapters scramble your calls rendering the interception of your information unlawful. ***Pvt* SQUELCH™** modules combine CTCSS tone encoding & decoding *and* voice inversion in one small package. Your transmissions are separated from others sharing the same channel and your messages can only be understood within your designated user group. To place an order or to receive free product bulletins and application notes call us direct at **1 800 638-5577.**

MX·COM, INC.
MiXed Signal ICs and Modules

Registered to ISO 9002 Certificate No. A1732

*Motorola and Radius GP300 are trademarks of Motorola, Inc.

Circle (82) on Fast Fact Card

USE COLOR

Advanced RF Design, Inc.
Low Noise Preamps
150-170 MHz Gain >24 dB NF <0.4 dB
450-470 Mhz Gain > 18 dB NF <0.45 dB
Priced from $65.00 to $70.00
1 yr. warranty
Call (609) 448-0910 (9 AM-9PM eastern)

USED 2-WAY RADIOS
Call Sid Cohen
at AIR COMM—Phoenix, AX
(602) 275-4505 • Fax (602) 275-4555
30%-70% savings on Motorola, GE, EFJ mobiles, base stations, portables, pagers, repeaters—primarily solid state—all frequency bands. Also, accessory items: Motorola "**Systems 90**" control heads. **PL and paging reeds,** channel elements. Cash quotations made for purchase of above equipment.

AIR COMM
4614 E. McDowell Rd.
Phoenix, AZ 85008

Equipment for sale

Compatible Motorola® Radio Programming Equipment

PA-I Programming Adaptor...$119.95
- Compatible with "RIB" unit
- Rugged steel case
- Power LED

NOTE: Hardware Only. Software sold by Motorola and other products are Trademarks of Motorola, Inc.



FULL LINE OF PROGRAMMING CABLES AVAILABLE
NEW RADIUS SP50 $Call
Package Deal Discounts, too!
GP300/P110, HT600/P180, STX
Genesis, VISAR, JEDI, HT-M1
SABER, SPECTRA, RADIUS
MOBILES, MAXTRAC, and Model



PA-III Pocket Programmer...$169.95
- Micro-Size Design for Convenient Portability and Field Use
- Uses Surface Mount Technology (SMT)
- Rechargeable — Works for hours on one charge



PA-II Programming Adaptor...$139.95
- Contains rechargeable NI-CAD Batteries: Perfect for field use and Portable, Laptop & Notebook Computers
- Status LEDs: Power On and Charge
- Power Switch
- Power / Charger Included
- Runs for 8 continuous hours from a full charge



Order Desk:
1-800-752-3571
Polaris Industries

Color Literature Available.
Same Day Shipping from Stock!

141 West Wieuca Road • 300-B • Atlanta GA 30342-3251 • *Tech Info: 404-252-3340* • FAX: 404-252-8929

Circle (83) on Fast Fact Card

MOTOROLA
USED EQUIPMENT
BUY-SELL
- LTR & MOTOROLA
- Conventional & Trunking
- Site Equipment • Paging Transmitters
- EFJ • Kenwood • Uniden

Mobiles Portables

BUY DIRECT AT
WHOLESALE PRICES
- Quality Service
- Best Prices
- Largest Inventory
- Fast Delivery

BUY & SELL

Buy-Comm-Co, INC.
29669 N. 45th Street
(602) 585-3900
FAX: (602) 585-6900
USA • PHOENIX, ARIZONA

MECHEM ELECTRONICS

Mailing Address:
P.O. Box 7846
Fredericksburg, VA 22404
3605 Loren Whitney Drive
Massaponax Business Park
Fredericksburg, VA 22408

Portable Repeaters PL: VHF & UHF;
DES & DES XL
Portable Test Sets
Nicad Eliminators
Single And Rack Chargers
CISCO Transmitters and Receivers
Speaker Microphones

BASES and REPEATERS
30-36; 36-42; 42-50, 100W, C.D.
150-162, 162-174 100W, C.D.
450-470, 75W, C.D.
R 1801 DAC/Programmer
Consolettes; Desktops and Remotes

Many items in stock, call with your requirements.
We have the R1801 DAC for your programming needs. Call us with your requests.

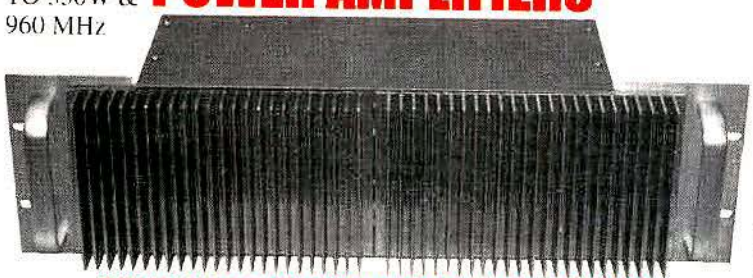
Phone: (703) 891-0569 We accept VISA and Mastercard Fax: (703) 891-0538

Circle (84) on Fast Fact Card

FOR SALE
15 SMR CHANNELS
2 PAGING CHANNELS
6 SHARED REPEATERS
6 TOWERS
Located in West Texas
Please send Inquiries to:
MRT Dept.# 944
9800 Metcalf, Overland Park, KS. 66212

PTEK

TO 350W & 960 MHz **POWER AMPLIFIERS**



1814 SCHOOLDALE DRIVE SAN JOSE CA 95124
408-448-3342 FAX 510-279-5912

CONTINUOUS DUTY; REPEATER & PAGING
CALL 408 448 3342 FOR SPECIFICATIONS AND PRICING

Circle (85) on Fast Fact Card

CHANNEL ELEMENTS
YOUR FREQ. - $20.00
with trade-in/3 working days

CRYSTALS $9.95
MAKON, TEKK, UNIDEN/7working days

CEH/Kirby Enterprises
4120 Kirby Rd. Cincinnati, OH 45223
1-800-237-9654
FAX: 513/542-8870

• MOBILES • BASES • PORTABLES • PAGERS • REMOTES •
• RCA • MOTOROLA • GE •
• BUY • SELL • TRADE •

PCI — PEKAAR COMMUNICATION INC.

$ Specials of the month $ *Steve's back, formerly of Gregory Electronics Corp.*

GE Phoenix SX Model N5HH1W40PB highband w/dual priority scan & accs	SPECIAL $700
Motorola MT500 Portables Hi band 2 Freq Omni Style w PL	$100
Motorola MCX100 Model M5D 44EMA1000 UHF 406-470 range less accessories	$50
Motorola Mitrek Model T51JJA 2900 60 watt 42-50 range 4 freq with accessories, clean, no PL	$150
Motorola MOCOM 70 U41BBA 1900 60 watt 42-50 range 4 freq w/access, clean, no PL	$65
GE MPE Portable Model P66SHBWBMX 450 to 470 range, 2 freq w/CC	$75
GE PE Portables Model PE65RBW 450 to 470 range, 2 freq, w/CC	$50
GE PLS Portables UHF 450-470 range w/battery and charger	$175
Regency Model (TR280) Mobile front mount high band 2 freq w/mic	$90
Motorola MICOR Mobile U54HTA 45 watt UHF 450-470 range w/access	$125
Catalog Available	Call (937) 372-0704

• BOARDS • STRIPS • ACCESSORIES • ELEMENTS • REEDS •

LAND MOBILE RADIO BBS
Buy-Sell-Trade used radio equipment with hundreds of other dealers nationwide. Call with your modem to register now.

FCC Database
ONLINE
Low Annual Fee
No Per Minute Charge
The Commline BBS
313-854-6441

Classified

Equipment for sale

Sutter Buttes 2 Way

10	GE Mastr II 800w UHF comm Rptr SC75YAS88B	$1995 ea
2	Motorola Micor 100w VHF Rptr C73RCB1110D	$1495 ea
1	Motorola Micor 12w UHF Rptr C34RCB6106B	$1195 ea
1	Motorola Micor 100w VHF base C63RCB3105A	$675 ea
50	Mitrek 110w LB 42-50 w/kee T81JJA8900CK	$350 ea
2	Motorola Mitrek 110w consolette 42-50	$550 ea
10	Motorola T-1900 series DC remotes	$60 ea
2	Motorola T-1605CM tone remote	$125 ea
12	Motorola Series 90 Local remote S-1903CA	$ 60 ea
6	Motorola Series 90 DC remote S-1902AD	$ 90 ea
1	Motorola NTN5148 800 portable amplifier	$175
1	Motorola L35TRK6135 Flexar 800 conv DC	$95 ea
3	Motorola L35TRB6100AM Maxar base 800 conv	$95 ea
3	Motorola MX rapid charger NLN-8855	$75 ea
6	Motorola P 100 rapid charger NLN-4864	$35 ea
3	GE MPL VHF 2w PS5JJ65BEN	$95 ea
50	GE Mastr II microphones	$10
50	GE Mastr II control cables	$10
50	GE Mastr II 4f scan heads	$10 ea
6	GE Deskon II DC remote	$75 ea
1	GE Mastr II pole count out door cabinet	$195 ea
1	Kenwood TK-830 75w UHF 32f w/mnt mic kit	$599
1	Kenwood TK 230 VHF 20f w/key pad	$295
1	Kenwood TK-250 VHF 32f w/key pad (demo)	$495
7	ASP-572 Low profile antenna	$15 ea
40	Vertex FTL-1011B4 4f 60w 39-50mhz	$495

Misc Mastr II & Micor tone remote station cards

Also available Kenwood, Uniden, Standard & Vertex products.

PH: 916-674-7532

FAX :916-674-1941

WE BUY AND SELL USED MOTOROLA, GE AND ERICSSON FM TWO-WAY RADIOS

SCHAEFER RADIO CO.
130 West Fayette St.,
P.O. Box 395
Denver, IA
50622

PHONE:
(319)
984-6115
FAX:
(319)
984-6220

2 ea MTX9000, 900 MHz H01WCC4DB3A
12 ea MAXTRAC, 800 MHz, D45MQA5GB5AK
34 ea MOSTAR, 800 MHz, D451LA5G00DK
2 ea MICOR Bases, 460 MHz, B84RCB1105AT
4 ea MICOR Bases, 460 MHz, D64RCB1105AT
3 ea MASTR II Bases, 460 MHz, VC85RAS88B
3 ea MASTR II Bases, 155 MHz, DC76RAD66A
5 ea MICOR Bases, 460 MHz, C54RCB3106
2 ea RADIUS R100 Rptrs, 460 MHz, Q2931B
2 ea SYNTOR X, 460 MHz, 174VBJ7204AK
7 ea GE MASTR II, 460 MHz, MC65KCU88A
30 ea MICOR, 460 MHz, T54RTA6903
5 ea MICOR, 460 MHz, T54RTA3903
1 ea MAXAR 80, 460 MHz, D34TSA6300
2 ea MAXAR 50, 460 MHz, D34JJA3300AK
3 ea GE MLS, 460 MHz MLSL160
11 ea M1500, 460 MHz, H34BBU3124
1 ea MICOR Base, 155 MHz C73RTB3105
10 ea MITREK, 153 MHz, T83JJA3900
22 ea MITREK, 153 MHz, T43JJA3000
2 ea MICOR Bases, 47 MHz, C71RTB3406
100 ea MITREK, 47MHz T81JJA4000
7 ea MITREK, 48MHz, T51JJA4900
100 ea MICOR, 47 MHz T/T1RTN3100
1 ea MICOR BASE, 37 MHz, C71RTB1406
20 ea MITREK, 31 MHz, T81JJA4000
2 ea MICOR Bases, 37 MHz C71RTB1406
15 ea Tone Remote Consoles, T1604M
60 ea Tone and DC Remote Desk Sets, Mixed Models: T1926, T1380, T1902
29 ea Local Control Desk Sets T13/0 & T1903
4 ea CENTRACOM II Single Bay Tone Remote, MLM w/I&R Modules
5 ea CENTRACOM Empty Cabinets
2 ea LNP Code Programmers, P1001BX
25 Sets MOTRAC Accessories
69 ea M1500 Omni Std Chrgrs., NLN4561
18 ea M1500 Slimline Rapid Chrgrs., NLN4565
2 ea MICOR IMTS Bases, 152 MHz, Q1404B
6 ea PULSAR II VHF IMTS Phones, Mixed Models
100 ea MINITOR I Pagers, 155 MHz, H03LAB1212
36 ea MIDLAND Portables, 466 MHz, 70-255B

Now in stock: ICOM®
ICOM F30LT VHF/ F40LT UHF portables. Retail $799/$859. Dealer $599/$639. Ninety-six channels, 8 digit alpha, program from its front panel KB OR PC. Upgrade from your H/U16. ICOMS bought, sold and repaired.

SWS Security (410) 879-4035

Hy-Q International (USA)

- **PAGER CRYSTALS**
- **COMMUNICATION CRYSTALS**
- **CHANNEL ELEMENTS**
 - **Recrsyalled**
 - **Complete Elements**

48-HOUR SERVICE AVAILABLE

(606) 283-5000
FAX: 1-606-283-0883
1438 Cox Ave., Erlanger, KY 41018
(Greater Cincinnati Area)

"Precision Quaility Quartz Crystals — Made to your Specifications"

Circle (86) on Fast Fact Card

FOR ALL YOUR ADVERTISING NEEDS
CALL RICK KELLEY 800-771-3351

COMPLETE CHANNEL ELEMENTS ON YOUR FREQUENCY FOR $25 - $35!!!

ORDERS ONLY:
1-800-237-6519
INQUIRIES AND IN LA:
504-361-5525

Motrac; Micor, Mocom; Mitrek; Etc. MT's, and GE Elements. Call for prices
Any desired Frequency available for fast delivery.
Lifetime Warranty on Crystals
Trade-in credit on your Old Channel Elements
We Buy Used Elements
Try us first. We always have *your* frequency available.

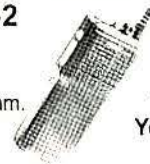
NKX
1814 Hancock St.
Gretna, LA 70053

(800)726-9015 (612)884-8352

- We Have Fast Service.
- We Have a Flat Rate Repair Service.
- We Have a Complete Dealer Support Program.
- We Have a Large Variety of Accessory Items Available

Wholesale Prices to Dealers Only

RADIO COMMUNICATIONS WHOLESALERS



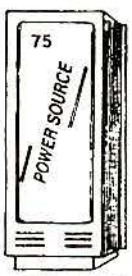
NOW Featuring TEKK Portables!
Our Prices will Surprise You Even if You Buy Direct from the Factory!!!

- ☆ **Full Line Distributor of Tekk**
- ☆ Many other brands also available.
- ☆ Your One Stop Warehouse for All Your Commmunications Equipment Needs.

24 Hour a Day FAX
(612)884-8356

Circle (87) on Fast Fact Card

TPS
POWER SUPPLIES



75 AMPS
Continuous Duty
9 POUNDS
•LOW RIPPLE•
•CURRENT LIMITED•
•FILTERED•
•REGULATED•
•EFFICIENT•
•MOV PROTECTED•

7 TO 75 AMP MODELS AVAILABLE

***DuraComm** Corporation*
438 NW BUSINESS PARK LANE
KANSAS CITY, MO 64150
1-800-467-6741
Fax 1-816-741-7499

CLEAN USED GEAR

Cushman CE-4 & CE-6 Service Monitors
GE Phoenix SX VHF, 2/16 CH & Scan
GE MLS LB, VHF, UHF 2/8/16 CH & Scan
GE MASTR II & Exec II LB, VHF, UHF
GE MVP, VHF
GE MASTR II Base/Rptr LB, VHF, UHF
Motorola Mocom, Micor, Mitrek LB, VHF, UHF
Motorola Moxy, Maxar,-50, -80 LB, VHF, UHF
Motorola Mostar 800T
Motorola Base/Rptr/Consolettes LB, VHF, UHF
Standard GX3000 VHF, UHF 64 CH Synth/Scan
Standard 966L LB, 75 Watt, Synth
Mostar VHF, Maxtrac 900 MHz

NEW STANDARD RADIOS AT DISCOUNT!! CALL NOW
Harris Alpha 2000E VHF IMTS
Motorola Pulsar VHF IMTS & Others
Motorola MT500 LB, VHF, UHF HT
Motorola MT/HT/ Gang Chargers
Standard HX300, 320, 734, 834 VHF, UHF HT
Standard HX400 VHF, UHF 25 CH Synth 5W HT
Uniden SPH & SPU 8 CH Synth HT
Wescom 2 GHz Microwave, MUX
Standard GX-1500U
GE Deskon II DC Remotes, Motorola Local Remotes
MORE - MORE - MORE - MORE - MORE - MORE

VersaTel

We Buy Used Equipment - CALL!
Ph: 1-800-456-5548
Fax: 1-307-266-3010

Circle (88) on Fast Fact Card

WEST COAST RADIO

ANNOUNCES ITS FIRST EVER

SP50 BLOWOUT!!!

ALL SP50 MODELS

VHF, UHF, 2, 6, & 10 CH

STD. & COMPACTS

TRADE IN ANY TWO-WAY RADIO WHEN YOU PURCHASE AN SP50 & YOU'LL PAY *LESS THAN THE DEALERS COST!!!*

TRADE-IN RADIOS NEED NOT WORK!!!

NO TRADE-INS ? THAT'S O.K.,
WE'LL GIVE YOU A *WHOPPING 40%* DISCOUNT
OFF ANY SP50 ON ANY QUANTITY PURCHASED!!!

SALE ENDS 11-30-95

800-881-6722

Circle (89) on Fast Fact Card

Equipment for sale

Now, here's a switch!

CHARGEGUARD®

automatic ON/OFF timer switch for two-way radios, cellular phones

EASY TO INSTALL.
NO IGNITION SWITCH CONNECTION!

PROGRAMMABLE.
15 MINUTES TO 15 HOURS!!

Prevents Dead Batteries.

MADE IN U.S.A.
PROTECTS YOUR RADIO.
SUGGESTED LIST **ONLY $74.95** MODEL CGIB-12N
12 AND 24 VOLT MODELS AVAILABLE

CALL NOW FOR MORE INFORMATION!

ASK ABOUT OUR *NEW* DEALER KIT!!



CHARGEGUARD
400 Highland Avenue
Altoona, PA 16602
800-458-3410
1991 ChargeGuard

Circle (90) on Fast Fact Card

AE-1 ANI / ENI*
High Speed DTMF Encoder

The AE-1 is a High Capacity **MICRO MINIATURE ANI / ENI DTMF ENCODER** designed into a micro computer to generate the most precise, clean and transit-free DTMF signal ... ever !

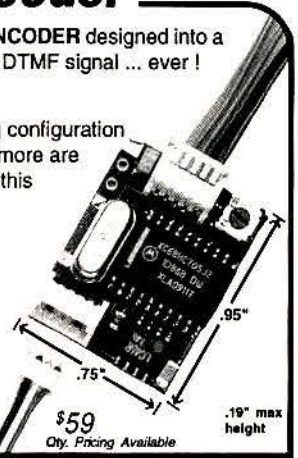
The OPTIONS and POSSIBILITIES of the AE-1 are ENDLESS !

Being familiar with the PIPO ANI VER 4.0 features, any DTMF string configuration of pauses, waits, delays, speed adj., xmtr ptt, memory connect and more are possible. Superb engineering and surface mount components allow this unit to fit into the smallest radio, hand held or even a microphone.

FEATURES
- Non-Volatile Memory
- Micro Miniature Jack / Plug
- 5, 10, 20 DPS Or Custom Time Base
- ANI / ENI 90 Digits Each
- 9-26 VDC @ .5 ma
- Mic Mute / PTT Output
- 1 kHz Tone Feature
- CW ID Option

EASY PROGRAMMING
- Free Factory Programming
- Field Programmable
- PC Programmable W / Pipo Software
- Programmable From Pipo DTMF Encoder / AE-1 Programmer
- Re-Programmable Anytime

* ANI ... Automatic Number Identification
* ENI ... Emergency Number Identification



$59 Qty. Pricing Available
.19" max height

Pipo Communications CALL 916-644-5444
Emphasis is on Quality & Reliability or FAX 916-644-7476
P.O. Box 2020 • Pollock Pines, California 95726-2020

Circle (91) on Fast Fact Card

REMOTE CONTROL ANYTHING...

Anywhere, with the PT8-OC POCSAG Remote Control Switch. Uses standard paging messages for control of up to 8 outputs.



To order call **PageTap, Inc.**
800-735-3650 or 303-337-4811
Fax: 303-337-3084

MOTOROLA Radius®

CALL *NOW* for HUGE INVENTORY REDUCTION SALE ON: VISARS, MTX 8000 & 9000's SPECTRAS, MINOTOR II's, AND PRIVACY PLUS MOBILES. ALL FROM OUR DEMO FLEET

1-800-249-1250

WETEC ELECTRONICS
VISA ACCEPTED

Circle (92) on Fast Fact Card

WANTED: USED SERVICE MONITORS

IFR • MOTOROLA • MARCONI • HP
SALE: CUSHMAN CE50A-1/TG-$3600, CE50A-1-$2700, MOTOROLA R2001D-$5900, R2200A-$4200, MARCONI 2955A/2957A $4900

Radio One
PH:716-661-9964; FAX:716-763-0371

USE COLOR TO MAKE YOUR AD STAND OUT

CELLULAR & PAGER LABELS

LABELS THAT STICK!

Labels for pagers, cellular phones and two-way radios with your company's logo. Warranty labels for batteries. Bar code and printing systems. Call us for free samples.

ADVANCE LABEL & TAG

1725 N. McDonald St.
McKinney, TX 75069-8230

1-800-466-5345 FAX: 214-548-2518 1-214-542-5345

"Our years of experience are your best Insurance"

Buy Direct — **GENERAL COMMUNICATIONS** — At Wholesale Prices

DISTRIBUTORS OF MOBILE COMMUNICATIONS EQUIPMENT

Largest Inventory • Quality Service • Fastest Delivery & Best Prices

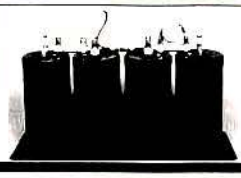
5157 Anton Drive • Madison, WI 53719 • 608-271-4848 • FAX 608-274-2080

800-356-3200

Because your business takes you everywhere

VISA — GE Mobile Communications — MasterCard

Equipment for sale



• Base Station Antennas
• Cavity Filters
• Multicouplers
• Duplexers

DECIBEL

distributed by
Communications Associates
A Hutton Communications Company
(800) 435-9313 Order Fax (800) 284-4934

• Power Amplifiers
• Combiners
• Filters

Call Today!



Circle (93) on Fast Fact Card



WholeSale prices on 2-way radios & more!

Authorized Distributor
Mobile Communications

Sharp COMMUNICATION Distribution Center
2-Way Sales to Radio Dealers Only

TELEWAVE
Site Management
SAMLEX
Power Supplies
RFI Connectors
WHELEN
Warning Signals



SHEILA TIM JIM

PRODUCT TrueValues SERVICE

ORDER TODAY = SHIP TODAY

1-800-548-2484

3403 Governors Drive • Huntsville, AL 35805 • Fax 205-539-1663

Circle (94) on Fast Fact Card

HENRY RADIO

IN STOCK, BEST PRICES, QUICK SERVICE

ASTRON CORPORATION

MAXRAD
State of the Art Antennas

BIRD

Eimac

Radius

HENRY AMPLIFIERS

YAESU

We also stock:

AEA	Larsen
Centurion	Maxon
Comm. Spec.	Maxrad
Connect Systems	Opto
Create	Solar Panels
Cushcraft/Signals	Telex
Henry Cables	Tempo
Hustler	TohTsu
Icom	TPS
JBRO	Uniden
Kenwood	Wavetek

TOLL-FREE (800) 877-7979

HENRY RADIO

2050 South Bundy Drive
Los Angeles, CA 90025

Phone (310) 820-1234
FAX 310-826-7790

Circle (95) on Fast Fact Card

WANTED: USED RADIO SERVICE MONITORS

BUY/SELL-MOTOROLA/IFR/CUSHMAN/WAVETEK

SALE: IFR-1500-$7,900, IFR-1200-S $5,900, IFR-1000A $2,500, IFR-1000S $3,500, WAVETEK 3000B $2,500, WAVETEK 3000S $3,500, CUSHMAN CE-50/A1 $3,900, CUSHMAN 6030 $5,000.

RF IMAGING AND COMMUNICATIONS
408-929-2244 / 408-691-0483
PAGER: 510-498-6875

FOR SALE:
MOTOROLA R-2038/D/HS
SYSTEM ANALYZER

FREQ RANGE 1MHz TO 1GHz, SPECTRUM ANALYZER, DUPLEX GENERATOR,SWEEP MULTIMODE CODE SYNTHESIZER, CELLULAR

ASKING PRICE $6250.00 EA.
11 UNITS AVAILABLE

RF IMAGING AND COMMUNICATIONS
408-929-2244 / 408-691-0483
PAGER: 510-498-6875

USED EQUIPMENT FOR SALE

25 HT600 4w 6F 470-490 w/rapid chrgr
2 Syntor XX VHF mobiles 100 watt 8F scan
8 Syntor XX UHF mobiles 75 watt 8F scan 470-490
1 MICOR 250 watt UHF Paging Base
1 MICOR 350 watt 35.68 MHz. Paging Base
2 MSR2000 100 watt UHF Base 483 MHz tone. unused in factory box
2 MSR2000 100 watt UHF Base 483 MHz tone. unused in factory box
2 T1608CM Remote w/mic unused in factory box
1 MSR2000 100 watt UHF Repeater 483 MHz. w/ duplexer
1 SYNTOR XX 800 Trunk Consolette w/5 DGT9000 Desksets
1 Centracom II Dispatcher console w/CEB
150 Director II T&V Pagers w/chrgrs 35.68 MHz

ALL-COMM Technologies, Inc.
55 American Legion Highway
Revere, MA 02151
817-289-3000 FAX: 617-289-7300

CAL CRYSTAL LAB., INC.

CRYSTALS FOR ALL RADIOS

✦ Communication Crystals
All makes and models
✦ Channel Elements
Recrystalized and compensated

Competitive pricing!

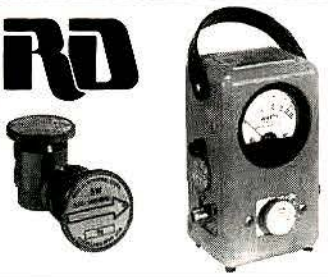
Emergency Service
For Crystals 24 Hours • 72 Hours • 1 Week
Normal Delivery 3 Weeks

800-333-9825
FAX 714-491-9825
1142 N. Gilbert Anaheim, CA 92801

Equipment for sale

AF CommSupply 1-800-255-6222

BIRD



Wattmeters, elements, loads and accessories in stock and available for immediate delivery.

- In Stock
- Competitive Prices
- Personal Service

Circle (96) on Reply Card

FOR SALE - SURPLUS PROPERTY

Bids are being accepted for two (2) Dictaphone Series 5500 40 Channel 24 Hour Logging Recorders - purchased in 1985

Equipment shall be sold on an "As-Is - Where-Is" basis. The succesful bidder will be required to pay for, pick up, and remove the equipment within five (5) days after notification of award.

Interested bidders are required to submit a Chesterfield County, Virginia, Invitation for Bid #7570. For a copy of Bid, call the Chesterfield County Purchasing Department, Chesterfield, VA. at (804) 748-1617, or send requests by FAX (804) 748-7515. Bid opening/closing date: January 5, 1996, at 2:00 p.m. No bids will be accepted after this date.

Circle (97) on Reply Card

CENTRACOM II
-Buttons and Labels-

$6.50 EACH — Engraved Buttons

All orders shipped within 7 days.
CENTRACOM II Reprogramming and Used Parts
NORTHEASTERN Communications, Inc.
Waterbury, CT 06708
(203) 575-9008

REPLACEMENT **REEDS** AND **FILTERS** FOR **MOTOROLA**
PART NUMBERS CALL **Bramco**
PH: 513-773-6255
FAX: 513-773-8003
VISA MasterCard

COMMUNICATION LABELS *For Pagers, Cellular Phones, and all types of custom labels*
Anchor Graphics Inc.
1467 LeMay #111, Carrollton, TX 75007
Tel. (214) 242-0439
Fax (214) 242-0959



FLIP-PHONE ELIMINATOR CHARGER
$8.95 EACH 12+
$9.95 EA./5+
MADE IN USA
PART# 5646M
(310) 809-5090 FAX (310) 809-1248

FOR MORE ADVERTISING INFORMATION CONTACT: RICK KELLEY: @ 800-771-3351

WHY PAY MORE?

SAVE THIS AD

MOT "MT1000" PORTABLES:

146-174 MHz	5w	99F	NEW*	$425
146-174 MHz	5W	99F	USED*	$375
438-470 MHz	4W	99F	NEW*	$425
438-470 MHz	4W	99F	USED*	$375
* W/ DTMF			ADD	$50

MOT "SPECTRA-TAC" VOTING EQUIPMENT:

COMPARATOR CHASSIS (W/O SQM)	$125
SIGNAL QLTY MODULE (SQM) ONLY	$75
COMM MODULE ONLY	$75
SAT R'CVR (BASIC CHASSIS)	$50
COMP CHASSIS W/ R'CVR (150/450 MHz PL)	$200
COMP CHASSIS W/ R'CVR + (3) MODULES	$350

EF JOHNSON EQUIPMENT - - FACTORY NEW:
EFJ "AVENGER" GX SERIES: 150/450 MHz 99F Digital Display

148-174 MHz	25W	(NB or WB)	NEW $275
148-174 MHz	40W	(NB OR WB)	NEW $300
440-475 MHz	25W	(NB OR WB)	NEW $300
440-475 MHz	40W	(NB OR WB)	NEW $325
400-435 MHz	25W	LIMITED QTY.	NEW $275
465-500 MHz	25W	LIMITED QTY.	NEW $300

EFJ "AVENGER" RADIO ACCESSORIES:

5030-018	5W EXT'L SPEAKER	NEW $18
5030-012	REM MNT KIT	NEW $50
5030-011	220VAC P.S.	NEW $60
5030-014	BASE MIC	NEW $45
5030-021	DTMF DEC MODULE	NEW $35
5030-022	5-Tone DEC MODULE	NEW $40
5030-030	PROGRAMMING PC I/F CABLE	NEW $25
-----	PROG SOFTWARE/SVC MANUAL	+ CALL

EFJ "GT-ML81": 800 MHz 15W LTR 20SYS/10SUB, ALPHA-NUMERIC DISPLAY NEW $395

MISC. RECENT ARRIVALS

MOT "MARATRAC" VHF 100W 99F (A7)	$550
MOT "MITREK" VHF 100W 4F DPL	$300
MOT VPN1013A AC P.S.	$50
GE MVS AC/DC P.S. (NPPS1)	$40
GE PHX SERIES DESK MIC (N5MC05)	$15
GE PHX SERIES 120/220 VAC, 50/60 H2 (19D430225G1) NEW	$60
EFJ FLEETCOM II AC/DC P.S. (239-0211)	$35
REDICODE DTMF MIC (EM1002)	$5
ASTRON RS12(D.A.)	$45

AIR COMM



TEL: (602) 275-4505
FAX: (602) 275-4555
4614 E. McDowell Road
Phoenix, AZ 85008

SAVE THIS AD

Circle (98) on Reply Card

Equipment for sale

Radius Radius Radius Radius Radius Radius

Motorola Radius®, where QUALITY IS #1

But where we want to be dead last when you call for pricing!

We accept TRADE-INS on your late model Motorola equipment

"NEW" ☆ Maxtrac Remote Mount Kits ☆
8 foot = $149.99 ea.
18 foot = $159.99 ea.

THANK YOU FOR YOUR RESPONSE!
YES, YES, YES!!
We'll run this special for an added TWO Months

- **SP10s AT COST!**
 VHF CSQ/PL, $144.00/$173.00 ea.
 UHF CSQ/PL, $161.00/$191.00 ea.
- **Buy 20 Units and receive an SP10 of your choice absolutely FREE!**
- **A FEW SALESMAN DEMO VISARS, MTX 8000/9000, MT 2000 & HT 1000's and yes JT 1000's remain.**
- **Two batteries supplied with every GP purchased at dealer cost.**



PROCOMM

Information:
805-497-2397
805-494-5078
805-497-3430

Ordering: 800-497-2394

24 Hr. FAX:
805-494-3115

BUY • SELL • TRADE • CLEAN WORKING EQUIPMENT

LOW BAND BASES & REPEATERS

20 MICOR 30-50MHz 100W	from	$995
15 MASTR II 25-45MHZ 100W	from	$995
3 MICOR 30-50MHz 375-700w	from	$1495
3 MASTR II 30-50MHz 350-500W	from	$1495
10 Mocom 70 Consolettes 30-50MHz 60-100W	from	$295
10 GE EXII 30-50MHz 60W	from	$250
6 GE DELTA-S 36-50MHz 60-100W	from	$395
3 MICOR Repeaters 110W 36-50MHz	from	$1495
1 MIDLAND SYNTECHII 35-42MHz 50W	from	$395

LOW BAND MOBILES

8 Syntor X-9000 29.7-53MHz 110W	W/A	$895
30 Mastr II 25-30MHz 100W N/A	W/A	$100
50 Mitrek 39-50MHz 60W S-90 4FQ Scan	W/A $100	4/S $300
50 Mitrek 39-50MHz 60W STD 4 FQ	W/A $150	4/$500
10 Mitrek 30-39MHz 60W S-90 4FQ Scan	$100	4/$350
10 Mitrek 30-39MHz 60W STD 4FQ	W/A	$150
25 Mitrek 30-39MHz 110W 4FQ S-90	W/A $200	3/$500
20 Mitrek 30-39MHz 110W 4FQs-90	W/A $250	3/$600
10 GE Delta-S 36-42 MHz 60W 8ch STD	from.. W/A	$150
5 GE Delta-S 42-50MHz 100W 8ch STD	W/A	$395
200 GE EXII 36-42MHz 60W CG	OFFER..	
100 GE EXII 36-42MHz 110W CG	OFFER..	
50 Mocom 70 36-42MHz 60W PL	W/A $100	5/$400
5 Mocom 70 36-42 MHz 110W 4 FQ PL	W/A	$150
25 Mocom 70 30-36MHz 60W	W/A	$100

OTHER BASES/REPEATERS, PAGING TX

1-C45RCB1105AT 800MHZ 35W Repeater W/Duplexer-MINT		$2,995
3 Micor 75W UHF Community RPTR	from	$1495
10 900MHz GE Digital Paging TX 45W		CALL
5 Mot TRITON Bases HF-SSB 125W 1.6-18MHz		CALL
5 Mastr II MK-5 Repeater		CALL
4 Mastr II 100W VHF RPTR	from	$1995
5 Exec II Bases 30-60W Most bands	from	$295
15 Mocom 70 Base 45-100W Most bands	from	$695
2 Delta Bases 60-100W Most Bands	from	$695

MOBILES W/A= With Access, N/A= NO Access

800 MHZ		
50 Syntor XX T45VBJ7000AK		OFFER
8 MOT P+ 250, 500, 750	from	$200
150-175 MHz		
4 GE Ranger 45 Watt 16 CH	W/A	$295
20 Micor 110W PL	from	$100
10 Mitrek 110W 4FQ	from	$250
8 Syntor X 110W	from	$250
10 MOT PAC-RT	from	$150
10 Mastr II PLL Digital 60W	W/A	$295
60 Mastr II 100W	from	$100

MISC ITEMS

20 GE VOTERS	from	$395
50 MOT T-1600 DC or Tone Remotes	from	$150
20 MOT T-1379-1383 DC or Tone Remotes	from	$50
25 GE Mastr Contrlr Tone or DC Remote	from	$150
20 MOT T-1902-1904 Tone & DC Remotes	from	$50

FCC 1ST CLASS RADIO TELEPHONE GENERAL CLASS W5RHL
30 YEARS IN COMMUNICATIONS
We do not buy/sell pagers, no portables or parts
Minimum order $100, No COD'S

BARNETT ELECTRONICS, INC.
Hours: 8:30-5:00 M-F CST
8718 Whilhite Lane
N Little Rock AR 72120
INFO: 501-835-7066 FAX: 501-835-8766
800-423-3858



BOB BARNETT

Circle (100) on Fast Fact Card

Computer software

Applied Spectrum Research

Frequency Management
Consultation
Software Development and Planning

2975 Valmont Rd, Suite 100
Boulder, CO 80301 USA
(01)303 444 4871
Fax: 303 444 4872

John P. Murray

Find Solutions

To Your RF Coverage and Site Management Problems... On your own PC!

Whether microwave, multi-site, or field strength, coverages, our Terrain Analysis Package (TAP)™ helps you understand everything from dBu to 3-D plots and site management software. Give us a call and we'll tell you how. Do "what if" studies and solution analysis in-house!

Call for free brochure & demo disk.



SOFTWRIGHT, LLC
1010 So. Joliet St, Suite 204
Aurora, CO 80012-3150 USA
Tel. (303) 344-5486
TeleTAP (BBS); (303) 344-5378 (9600, N,8,1)
Fax: (303) 344-2811 e-mail sales@softwright.com

Circle (101) on Fast Fact Card

RFCAD™ Runs "What If" Scenarios in Minutes Instead of Hours.

Run Comprehensive RF Propagation Studies in Windows™.

RFCAD™ 1.3 propagation studies show attenuation due to land use/land cover, buildings and obstructions, as well as other RF characteristics based on digital data files.

- Multiple models available, Longley-Rice and Biby-C
- 3 arc second and land use/land cover data available
- Produce maps with multiple site analysis

Run propagation studies in minutes, not hours. RFCAD™ 1.3 is fast, user-friendly and available by geographic area.

For more details call
1-800-441-0034

Communications Data Services
Incorporated

Leaders in wireless products and services since 1983

Circle (102) on Fast Fact Card

Service - Sales - SMR Billing
Pager Billing - Accounting

Computer Resources, Inc. has the solution for all types of two-way radio billing and management problems. Systems are available on DOS, Novell, Lantastic and UNIX. The CRI system is modular and completely intergrated. We can provide complete solutions including software, hardware, and training.

205-987-1523 / 205-987-1709 FAX

Circle (103) on Fast Fact Card

Radio Propagation Software for PC's / WINDOWS

- LMR Predicted Area Coverage - Multi-Site Composite Coverage Maps
- No Radial Generation Required - Real Time Propagation Study / Profiles
- DXF / HPGL Output - Direct Interface with AutoCAD, TurboCAD, etc.
- Multiple Propogation Models - Okumura, Field Strength, Shadow Maps
- VHF / UHF / Microwave Point-to-Point Path Profiles and Link Analysis
- 3 Second Digital Elevation Data on CD-ROM and Floppy Disk



Rocky Mountain Communications, Inc.
2023 Montane Drive East • Golden, Colorado 80401-9123
Tel: (303) 526-5454 • Fax: 526-2662 • BBS: 526-2723

PAGER & CELLULAR BILLING SOFTWARE
800-466-6261
CALL FOR DEMO
PAGE-1 SOFTWARE

CUSTOM RF SOFTWARE TOOLS

Coverage	Digital
•Digital/Analog	•Throughput
•Reliability	•Response time
•2D contours	•Fast Color Printer plots
•3D terrain grid	•Map Features

Simulcast Interference Minimization & Others
CMC CONSULTING (214) 612-8880

NORTON ENGINEERING

MICROWAVE SYSTEMS
- On-Screen Path Profile Design
- Diffraction Loss Calculations
- Reflected Signal Analysis
- Route and System Diagrams
- Map Crossings Graphic with Dimensions
- Performance Predictions - Analog & Digital
- High Resolution Graphic Printing - Printers & Plotters - Black/White & Color
- Reads 3-second Terrain Data

RADIO COVERAGE
- Coverage Diagrams - Single Signal Level - Black & White
- Coverage Diagrams - Multiple Signal Level - Multiple Color
- 360 Radials - 12.5, 25 and 50 Mile Radius
- User Defined Antenna Pattern
- Antenna Radiation Diagram Plot
- Relief Maps - Multiple Colors
- Reads 3 Second Terrain Data

10002 McDuff Court
Vienna, Va 22181
Phone: +1 703 938-5745
Fax: +1 703 938-9168

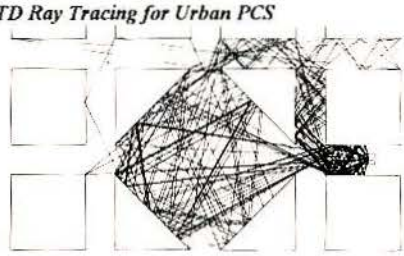
FREE BROCHURE AND DEMO DISK

Circle (104) on Fast Fact Card

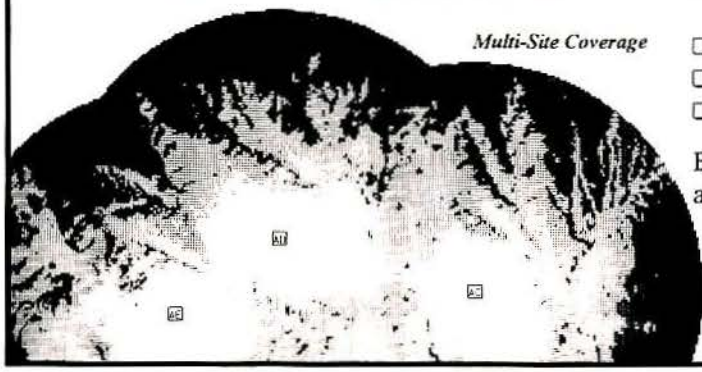
Computer software

PCS System Design

UTD Ray Tracing for Urban PCS



Multi-Site Coverage



With more than 20 years experience in propagation modeling, EDX is the world leader in innovative PC coverage and link analysis software. We offer proven, affordable PCS system planning tools including:

- ❑ Multi-transmitter coverage prediction with 2-D and 3-D plots of signal levels, C/I ratios, and most likely server studies (**MSITE™**)
- ❑ Microwave link studies with interference prediction from other links and PCS transmitters (**TPATH™**)
- ❑ Selectable propagation models (TIREM, Okumura, FCC, CCIR, etc.) with time and location statistics
- ❑ The first PC-based UTD ray-tracing software for urban PCS and indoor wireless LAN design (**MCS™**)
- ❑ The first complete US 3 second terrain database on a single CD-ROM
- ❑ Terrain databases for the U.S., Great Britain, Canada, Mexico and other countries on CD-ROM or diskette
- ❑ Custom terrain, groundcover, and building databases
- ❑ EDX programs are full 32 bit applications
- ❑ Demonstration disks available

EDX is your single source for propagation prediction tools and databases. Send for our full color catalog today.

EDX Engineering, Inc.
P.O. Box 1547, Eugene, Oregon 97440 USA
Tel: (503) 345-0019 Fax: (503) 345-8145

Circle (105) on Fast Fact Card

SOFTWARE BREAKTHROUGH

Save Time and Money
Managing Wireless Radio Communication Sites!

If You Manage One or Hundreds of Wireless Communications Sites, You Need ComSiteManager

- Site Facilities Information
- Track FCC License and FAA Data
- Track Leases, Rates and Billing Information
- Site Equipment Inventory and Maintenance Records
- Compatible With ComSitePlus Interference Analysis Software



COMSITE™ MANAGER
BY DOUGLAS INTEGRATED SOFTWARE

Call:
800-845-0408
904-656-8673
1350-E4 Mahan Drive, Ste 160,
Tallahassee, Florida 32308

Circle (106) on Fast Fact Card

Software For
FCC Forms 402 489 494
FCC Licensing and Price Quotes
Form 600!
Slattery Software
(941) 697-8008

Equipment Wanted

Equipment Wanted
Motorola, Johnson, GE
EFJ, Uniden, Standard
Buy-Comm-Co.
1-800-347-4121
FAX (602) 585-6900

YOU'VE HAD THE REST NOW GET THE BEST!
ADVERTISE IN MOBILE RADIO TECHNOLOGY
CALL: 800-771-3351

Tower space

NEED TENANTS??

Advertise your sites in the

NATIONAL COMMUNICATIONS SITE DIRECTORY

Dedicated to advertising antenna sites for lease

NEED SITES?

The NCSD contains thousands of prime antenna sites, all with space for lease *Just $15 per year.* For information call: Tel: (908) 462-5964 Fax: (908) 308-0633

"CLEAN" PUGET SOUND SITE

3230' AMSL (1600' higher than Gold MT)
Covers Seattle - Tacoma areas
160' and 80' Towers
Call with your requirements:
Gil Greenwood - Olympic Radio
1-800-257-7346 Fax: 360-377-2084

RESCO TOWER COMPANY

Sites available GA and SC

Call Miles McSweeney 803-686-6686

PRIME NORTHERN NEVADA SITES

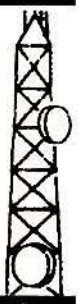
Our newest, Pond Peak, at 8035' AMSL, 2635' AAT, Emergency Power, Air Conditioning, Overlooking Reno, Fallon and the I-80 corridor.

702-825-2626

GREAT BASIN COMMUNICATIONS

40+ choice antenna sites in California.

- Stand-by Power / Air cond.
- Continuous Monitoring
- High-Security Access System
- Land available for developing your own site at Oat Mountain, Chatsworth



Meridian Communications

Great sites, great service, since 1956

Call Rich or Jack Reichler at

(800)400-SITE

AAT Communications Corporation



ON TOP OF THE WORLD

With over 1500 communications sites throughout the eastern US, AAT Controls the heights. And with over 40 years of specialization in telecommunications site managing, marketing, constructing, leasing and engineering, *AAT* has the experience to provide tip-top performance at a down-to-earth price. AAT will put you above the competition and on top of the world.

WHY CLIMB ALONE?

PCS COMPATIBLE ROOFTOP SITES
RECEIVE ONLY SITES

SITE MANAGEMENT DIVISION

PARKSIDE CORPORATE CENTER
292 Fernwood Avenue, Edison, NJ 08837
For more information contact: T.E. Smith
800-551-SITE • Fax: 908-417-4825

60 California Antenna Sites...

...and Growing



Newest Site: 3250 Wilshire Blvd. Los Angeles

Call for the latest listing of premier California sites

DIABLO COMMUNICATIONS, INC.

Northern California - Pt. Richmond
(510) 236-3700 Fax (510) 236-3799
Southern California - Burbank
(818) 842-5000 Fax (818) 842-5335

Circle (107) on Fast Fact Card

TEL: (708) 823-7713

CHICAGO TOWER LEASING CORP.

STAN STANN

COMMUNICATIONS TOWER & ANTENNA SITES FOR THE METROPOLITAN CHICAGO AREA

P. O. Box 31160
CHICAGO, IL 60631

HIGH AND MIGHTY IN THE GREAT SOUTHWEST.

130 premier wireless communication sites in Texas, Oklahoma, New Mexico, Arizona, Colorado and Nevada.

Cities served: Albuquerque, Santa Fe, Phoenix, Tucson, Las Vegas, El Paso, Midland, Odessa, Dallas, Austin and points between.

- *Single source for wide area coverage*
- *Professionally managed sites*
- *Seeking additional sites to serve your communication needs*

P.O. Box 5556 Abilene, Texas 79608 Tel. 915-690-5917 Fax 915-690-5819

CASTLE TOWER CORPORATION

SPECTRUM ENGINEERING COMPANY

THE BEST SITES IN
Houston, Chicago, Atlanta, Denver, Nashville, Louisville, New Orleans, Ft. Worth, San Antonio, & Corpus Christi
11111 Katy Freeway, Suite 360
Houston, Texas 77079
(800) 966-8885 Fax (713) 984-0066

Tower services

TowerWatch

Tower Monitoring Systems

- FAA Reporting and Logging (to meet FCC & FAA requirements)
- Lighting & Security Alarm Equipment
- Central Station Monitoring

Dealer Inquiries Welcome

1-800-475-1780

Circle (108) on Fast Fact Card

AMERICAN TOWERS AND STRUCTURES

• CELLULAR • MICROWAVE • UHF/VHF • • BROADCAST • SPECIAL • COMPLETE • INSTALLATION SERVICES • GUYED TOWERS • • SELF SUPPORTING TOWERS •

FOR YOUR CATALOG CALL OR FAX

TOLL FREE	PHONE	FAX
800-369-0159	712-252-0240	712-252-0371

Small cost.
BIG results!
MRT Classifieds.
Call 913-967-1923

Repair services

NS ELECTRONICS SERVICE INC.

COMMUNICATIONS MONITORS SALES & SERVICE
N.I.S.T. TRACEABLE CALIBRATION
CUSHMAN IFR
DISTRIBUTOR FOR SALES NEW-USED
OPTO ELECTRONICS, INC.

3610 Dekalb Technology Parkway
Suite 110/111
Atlanta, Georgia 30340
(404) 451-3264
Fax: (404) 458-8785

CALL

AUTHORIZED
CUSHMAN SERVICE

Loudoun Communications Inc.
Communications Systems
REPAIR DEPOT

QUALITY SERVICE ON MICROPROCESSOR BASED MOBILES, PORTABLES AND CONTROL HEADS. SURFACE MOUNT REPAIR. MOST REPAIRS $60 PLUS PARTS. FREE ESTIMATES.

Warranty Service Available On:
Ericsson/G.E. • Kenwood • Maxon

585 Factory Shoals Rd.
Austell, Ga. 30001 770-948-9566

SERVICE MONITOR REPAIR/CALIBRATION



Specializing in Service Monitors since 1973

We buy and sell used IFR monitors!

Phone (970) 962-9998
FAX (970) 962-3991

COMMUNICATION INSTRUMENTS

1714 SW 23rd Street, Loveland, CO 80537

4/95

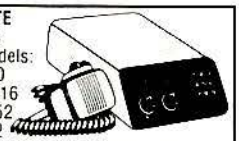
MOTOROLA
Authorized Service

- Authorized warranty Service
- Quick Turn Around
- Flat Rate Repair Available
- Free Estimates
- Quantity Discounts

COMMUNICATIONS SOLUTIONS
(719) 547-3683

$25.00 FLAT RATE
Plus Parts & Shipping
On the following models:

XLH-250	RH-250
RH-256	WH-2516
WH-2510	RFH-252
UC-102	UC-202
TRH-202	



REGENCY/WILSON

*OTHER MODELS—$30/HR Plus Parts & Shipping

MULTICOM
527 S Broadway
Moore, OK 73160
405-799-7356 800-880-7356

• FAST TURNAROUND
• FACTORY TRAINED
• VISA - MASTERCARD - COD

KENWOOD®

Flat Rates	Beltronics,Inc.	We sell
Repairs and/or Estimates	Dept MR 19 Proctor Hill Rd. Hollis, N.H. 03049	Parts - Accy
Mobiles $39	1-800-3-BELTRON	FREE
Portables $59 plus Parts/Shipping	We replace GUESS by TEST Let our 27 years of experience help you.	programming on new radios Daily UPS

MOTOROLA
PORTABLE & PAGER REPAIR

• PAGERS	$ 10 + PARTS
• PORTABLES	$ 29 + PARTS
• SYNTH. PORTABLES	$ 49 + PARTS

• QUICK TURN AROUND • FREE RETURN SHIPPING

TEL: 1-800-567-5636 FAX: 804-469-4900

ARCOM, INC. 13509 Boydton Plank Road Dinwiddie, VA 2384

Technical Services

Communications Resource Group

Specializing in: Wireless Licensing, Tower Research, FCC Research, System Construction, Field Service & Installation
2663 Valleydale Road, Suite 333,
Birmingham, AL 35244
Phone: (205) 991-8090 Fax: (205) 991-2033

Business Opportunity

FOR FAST RESULTS ... USE MRT CLASSIFIEDS CALL 913•967•1923 OR FAX 913•967•1735

TELECOM NETWORK
INCORPORATED

$$ CA$H IN $$
Earn Top Dollar
Loading Community Repeaters.
Alabama ✧ Georgia ✧ Florida
Tennessee ✧ Mississippi

FOR INFORMATION CALL:
800-494-3090

FOR SALE
25 Year old Two-way Radio, Mobile Telephone & Paging Co. Towers, Test Equipment, Repeaters, Parts.
Owner Retiring Soon!
(316) 397-5744
Eugene Lewis

Reprints

"Great article! Can we get copies for our clients and sales force?"



Whether it's an article, ad, or an interesting column, take advantage of this unique opportunity to promote your business and products through reprints – available from this magazine. Reprints are great promotional pieces and make excellent marketing tools ... all at a minimal cost.

Available in full-color or black & white, reprints can be obtained from any issue.

For a free price quote, contact Chris Lotesto, toll-free at 800-458-0479 or 312-435-2357.

Circle (109) on Fast Fact Card

$ Sell it *FAST!* In MRT Classifieds. 800•771•3351

Rentals

MOTOROLA Radius Rentals
- GP300, P200
- Mobiles, Repeaters
- Intrinsically Safe
- Dealers Welcome

1-800-822-MOSS MOSS COMMUNICATIONS

MOTOROLA
RADIO RENTALS
- MT1000, HT600, P200
- Intrinsically Safe
- All Types Headphones
- Mobiles & Portapacks
- Repeaters & Crossband Sets
- Dealer Inquiries Invited

1-800-283-COMM
EVENT RENTAL COMM., INC.

TWO-WAY RADIO
RENTALS & SALES
• DAILY •WEEKLY •MONTHLY
VERY LOW RATES!
FEATURING:
MOTOROLA PORTABLES!
BigHorn Communications
1-800-539-2220

Mobile Radio Technology™

CALL RICK KELLEY TO PLACE YOUR AD FOR THE JANUARY 1996 ISSUE

800- 771-3351

Ad index/hot line

Company	Page Number	Fast Fact Number	Advertiser Hotline
Advanced Receiver Research	44	35	203-582-9409
Air Comm	81	98	602-275-4505
Alexander Batteries	56	50	800-526-ALEX
Allen Telecom Group	IFC	1	216-349-8400
Andrew Corporation	19	14	708-349-3300
Anritsu Wiltron Sales Co.	32A-B,33	25	800-230-2972
AF Comm Supply	81	96	800-255-6222
Astron Corporation	27	20	714-458-7277
Avcom of Virginia	52	46	804-794-2500
Avtec Inc.	34	26	803-892-2181
Barnett Electronics	82	100	800-423-3858
Bird Electronic Corp.	45	36	216-248-1200
California Microwave	35	27	800-999-1920
Cellular Wholesalers, Inc,	62	57	800-395-0505
Chargeguard Corp.	79	90	800-458-3410
Cimarron Technologies	25	18	800-487-7184
Communication Instruments	86		303-962-9998
David Clark Co., Inc.	55	49	508-751-5800
Combined Technologies, Inc.	48	40	513-595-5900
Communications Associates	80	93	800-435-9313
Communications Data Services	83	102	800-441-0034
Communications Marketing Assoc.	65	60	303-371-8182
Communications Specialists	BC	3	800-854-0547
Computer Resources	83	103	205-987-1523
COMTELCO	58	52	800-634-4622
Connect Systems, Inc.	11	9	800-545-1349
CPI Communications Inc.	54	48	214-437-5320
Crystronics, Inc.	73	77	305-566-6949
Cushcraft/Signals Corp.	9	8	800-258-3860
Datacom Inc.	26	19	217-222-0160
Diablo Communications, Inc.	85	107	510-236-3700
Direct Power & Water Corp.	64	70	505-889-3585
Doppler Systems, Inc.	66	62	602-488-9755
Douglas Integrated Software	84	106	800-845-0408
DuraComm Corp.	68	64	816-746-8300
EAGLE	48,63	39,59	520-204-2597
EDX Engineering, Inc.	84	105	503-345-0019
El Paso Communication Systems	66	61	915-533-5119
Emergency Comms Center	81	97	804-748-1617
Gamber Johnson	18	13	715-344-3482
Grayson Electronics	29	22	800-800-7465
Haewa Corporation	68	65	800-783-4239
Henry Radio	61,80	55,95	800-877-7979
Hutton Communications	43	34	800-442-3811
Hy-Q International	77	86	606-283-5000
IDA Corporation	62	58	701-280-1122
IFR Systems, Inc.	39	30	316-522-4981
Larsen Electronics	31	23	800-426-1656
Leathersmith	50	43	800-233-0440
Loral Microwave-Narda West	57	51	916-638-5500
Mechem Electronics	76	84	703-891-0569
Meridian Communications	15	11	818-222-5655
Microflect	IBC	2	503-363-9267
Microwave Data Systems	53	47	716-242-9600
Midian Electronics, Inc.	17	12	602-884-7981
Midland International LMR	22	16	800-MID-LAND
Mobile Radio Technology Reprints	87	109	800-458-0479
Modular Communication Systems	36	28	818-764-1333
Motorola Flex	2,3	5	407-739-FLEX
Motorola Test Equipment	7,59	7,53	800-505-TEST
MX-COM, Inc.	75	82	800-638-5577
Natcom Inc.	41	32	800-844-8287
Norcomm Corp.	24	17	916-477-8400
Norton Engineering	83	104	703-938-5745
Ortel Corporation	37	29	818-281-3636
Packetcluster Systems	40	31	508-460-4000
PageCo	74	80	305-776-0031
Pana-Pacific	47	39	408-374-7900
Photocomm, Inc.	69	66	800-223-9580
Pipo Communications	79	91	916-644-5444
Polaris Industries	76	83	800-752-3571
Polyphaser Corporation	61	56	800-325-7170
Procomm	82		805-497-2397
PTEK	76	85	408-448-3342
Radio Express, Inc.	75	81	703-266-1928
RAM Communications Consultants	72	75	908-636-6970
Ramsey Electronics, Inc.	73	76	800-446-2295
RCW Distributing	77	87	800-726-9015
RMS Communications Group	74	79	904-873-0222
Rocky Mountain Comms. Inc.	83		303-526-5454
Santa Fe Distributing	70	68	913-492-8288
Sentry Manufacturing Co.	74	78	800-252-6780
Serviceware Corporation	69	67	613-521-7391
Sharp Communication	80	94	800-548-2484
Shure Brothers, Inc.	14	10	800-25-SHURE
SMC Electro-Mount	52	45	800-527-1079
SoftWright	83	101	303-344-5486
Solar Electric Specialties	32	24	800-344-2003
Stanilite	49	41	410-263-2481
TESSCO	21,23		800-472-7373
TowerWatch	86	108	800-475-1780
Transcrypt International, Ltd.	5	6	800-276-8799
TX RX Systems Inc	28	21	716-549-4700
Vega, A Mark IV Company	1	4	818-442-0782
VersaTel Communications	77	88	800-456-5548
Vocom Products Company LLC	50	42	800-USA-MADE
WAVETEK	42	33	800-392-8100
The Webb Group	46	37	615-647-9961
West Coast Radio	78	89	310-268-2464
Wetec Electronics	79	92	901-286-6275
WirelessWorld Expo '95	51	44	913-967-1969
Zetron, Inc.	20,60,67	15,54,63	206-820-6363



Circle (2) on Fast Fact Card

Microflect

Read All About It!

In Microflect's Component Catalog

Your one-stop source for

- Waveguide Support Systems
- Antenna Support Structures
- Tower Accessories
- Hardware

At Microflect, we've been busy making headlines. What's all the excitement about? Our comprehensive Component Catalog – quite simply, the industry's most extensive catalog. It's filled with well over 1,000 products, including application illustrations, new product descriptions, in-depth specifications and easy-to-reference pricing. Supporting this vast array of products is our highly knowledgeable staff, with the application and product expertise to help make your planning, engineering, purchasing and installing as easy as it should be.

You'll also appreciate Microflect's proven commitment to quality and close attention to even the smallest details, from product concept to completion. The result is a component product line known industry-wide for quality craftsmanship, precision and functionality.

We invite you to call today for your free catalog. If you'd like, we'll also send along our PC-based Component Catalog Pricing Diskette for easy price configurations. So read all about it... All it takes is one toll-free call.



Serving the Communications Industry since 1956.

(800) 547-2151 Ask for extension 901
FAX (503)363-4613
3575 25th St. SE · Salem, OR 97302-1190



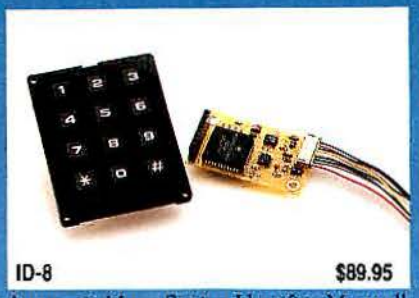
TP-3200 $279.95

Full Featured Shared Repeater Tone Panel with ALL 157 CTCSS/DCS codes. In Desktop or Rack Mount version.



CSI-100 $749.95

Video Modem. Sends and receives broadcast quality, single frame, color video over ANY narrow-band communications channel.



ID-8 $89.95

Automatic Morse Station Identifier. Meets all FCC ID Requirements. Fully field programmable with included keypad. 1.85" x 1.12" x .35"



TE-64 $79.95

Self-contained Encoder, Rotary Dial Selection. Great for the Benchtop. 5.25" x 3.3" x 1.7"



CC-1/CR-1 $49.95 each

Surface Mount Component Kits for repairing SMT circuits. CC-1 for capacitors/CR-1 for resistors.



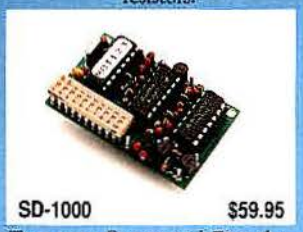
PE-1000 $224.95

Desktop Paging Encoder. Two-tone sequential, other formats available. 7.5" x 7.8" x 2.7"



PE-2P $54.95

Two-tone Sequential Encoder. Sub-assembly mounts inside radio or other enclosure. Multiple call capability. 1.25" x 2.0" x .4"



SD-1000 $59.95

Two-tone Sequential Decoder. Programmable unit provides switched outputs from two-tone paging calls. 1.25" x 2.0" x .4"



DTD-1 $59.95

Single Function DTMF Decoder. Provides switch outputs via DTMF. 1.25" x 2.0" x .4"



PE-4/PE-15 $99.95

Multiple Call POCSAG (RPC-1) Paging Encoders. Where direct control of local area paging is desired. 1.78" x 1.03" x .35"



DCS-23 $59.95

Digital Coded Squelch Encoder-Decoder. Programmable to all codes. 1.36" x 1.18" x .25"



TS-32P $57.95

Programmable CTCSS Encoder-Decoder. Tone squelch for any FM transceiver. 1.25" x 2.0" x .4"



TS-64 $64.95

Sub-miniature Programmable CTCSS Encoder-Decoder. 1.7" x .78" x .25"



SS-32SMP $27.95

Sub-miniature CTCSS Encoder. Jumper programmable. .53" x 1.0" x .16"



SS-32PA $28.95

Programmable CTCSS Encoder. Custom tones or audible tones also available. .9" x 1.3" x .4"

The Sky's The Limit!

For over 25 years... bringing you tone signalling products that are as reliable as the day is long. Combine this with same-day shipping, toll-free technical support, and our no hassle one year warranty, and you'll realize the sky's the limit in our efforts toward customer satisfaction.

Shown are a few of our most popular tone signalling products. Call for details on these and all your tone signalling needs. A free catalog will be mailed upon request.

COMMUNICATIONS SPECIALISTS, INC.
426 WEST TAFT AVENUE • ORANGE, CA 92665-4296
(714) 998-3021 • FAX (714) 974-3420
Entire U.S.A. (800) 854-0547 • FAX (800) 850-0547

VISA MasterCard

Outside USA or Canada: Jescom International, 1 Waters Park Dr. #117, San Mateo, CA 94403 USA · Phone (415) 574-1421 · FAX (415) 574-5297 · Also in Italy and Spain

Circle (3) on Fast Fact Card